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VOL. CXXXIII.—No. 3446] LONDON: FRIDAY EVENING, JANUARY 13, 1922 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Iron, Steel, Coal and Engineering Trades in 1921.

Physical and Optical Societies' Exhibition.

Co-operation of the Engineer and the Chemist.

Manchester's New Outfall Sewer.

Friction Lifters for Drop Stamps.

Harbours and Waterways in 1921.

Recent Developments in Power Station Design.—No. XXII.

Naval Construction in 1921.

Small Hydro-Electric Plant in Wales.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

1. SCREWS, IRON AND BRASS, FOR WOOD.
2. COPPER TUBING.
3. COPPER WIRE.
4. GLASS SHEET AND PLATE.
5. BRASS BOILER TUBES.
6. VERTICAL BOILER.
7. LAMINATED SPRINGS.
8. TYRES, STEEL, ENGINE.

Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Tuesday, the 31st January, 1922, for Nos. 1 to 4, and on Tuesday, the 7th February, 1922, for Nos. 5 to 8.

T. RYAN,
Director-General.
7164

Civil Engineer Required by the GOVERNMENT of ZANZIBAR for one tour of 29 to 30 months' service, as an ASSISTANT ENGINEER on WATER SUPPLY. Salary £600 per annum, rising by annual increments of £25 to £700 per annum. Free quarters and first-class passages.

Candidates, preferably single, must be A.M. Inst. C.E. or possess similar professional qualifications, and must have had good practical experience on Waterworks. The person appointed will be required to lay out and supervise the construction of waterworks, pipe line, and other details.

Apply at once, in writing, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/Zanzibar 11,271. 7176

British Standardised Steel
SAMPLES.
Issued jointly by
THE IRON AND STEEL INSTITUTE
AND THE
NATIONAL PHYSICAL LABORATORY.

These samples are now available, together with certificate of standardisation, at the price of 21s. per bottle, containing 50 grammes. They may be obtained post free by sending order with remittance, direct from

THE NATIONAL PHYSICAL LABORATORY (Metallurgy Dept., Teddington, Middlesex ; or by post or personal application from

The Secretary, NORTH MIDLANDS DISTRICT AUTHORITY, Dept. of Applied Science, The University, Sheffield.

Depots in other centres are being arranged.

The Standards at present available are :—

No. 5 Carbon (C = 0.65 per cent.) Acid O.H. Steel.
No. 6 Carbon (C = 0.10 per cent.) Basic O.H. Steel.
No. 1 Sulphur (S = 0.027 per cent.).

Others are in preparation and will be issued when ready. 7048

Leeds University.
DEPARTMENT OF COAL GAS AND FUEL INDUSTRIES (WITH METALLURGY).

SPECIAL COURSES OF EVENING LECTURES will be given during
JANUARY, FEBRUARY and MARCH
on

I. THE MANUFACTURE OF COAL GAS, by Dr. H. G. Colman, D.Sc., Ph.D., F.I.C.
IA. RECORDING GAS CALORIMETERS, by Mr. W. Wood, M.Sc., A.I.C.
II. REFRACTORY MATERIALS, by Professor J. W. Cobb, C.B.E., B.Sc., F.I.C.
III. METALLURGY, by Mr. P. F. Summers, A.R.S.M.

The Laboratory will be open on Wednesday evenings for students desiring instruction in Fuel Calorimetry and Pyrometry.

For further information apply to the REGISTRAR, The University, Leeds. 7126

University of London.

NOTICE IS HEREBY GIVEN that the SENATE will proceed to ELECT EXTERNAL EXAMINERS for the EXAMINATIONS above MATRICULATION as follows. Except when otherwise stated, Examiners will act in all Examinations in which the subject occurs. Where Examiners are to be appointed for (A) Intermediate Examinations only and (B) Final and Higher Examinations only, the fact is indicated after the name of the subject below.

FOR THE SESSION 1922-23.

EXAMINATIONS OTHER THAN MEDICAL.
AGRICULTURAL ENGINEERING.
SURVEYING (INTERMEDIATE, ONE).
URBAN PUBLIC SANITATION.
THEORY AND PRINCIPLES OF THE VALUATION OF LAND AND BUILDINGS.

FOR THE CALENDAR YEAR 1922.

ENGINEERING, CIVIL AND MECHANICAL (TWO).
ENGINEERING DRAWING AND DESIGN (INTERMEDIATE, ONE).

N.B.—Attention is drawn to the provision of Statute 124, whereby the Senate is required, if practicable, to appoint at least one Examiner who is not a Teacher of the University.

Application form (or forms, if more than one Examinership is applied for) and particulars of the remuneration and duties can be obtained from the External Registrar.

Candidates must send in their names to the External Registrar, Geo. F. Goodchild, M.A., B.Sc., with any attestation of their qualifications they may think desirable. (Envelopes should be marked "Examinership.")

It is particularly desired by the Senate that no application of any kind be made to its individual members.

If testimonials are submitted, three copies at least of each should be sent. Original testimonials should not be forwarded in any case. If more than one Examinership is applied for, a separate complete application, with copies of testimonials, if any, must be forwarded in respect of each.

E. C. PERRY,
Principal Officer.

University of London,
South Kensington, S.W. 7,
January, 1922. 7132

PUBLIC NOTICES

Corporation of Calcutta
WATERWORKS EXTENSIONS CONTRACTS, 1921.

The Corporation of Calcutta are prepared to receive TENDERS for :—

CONTRACTS I. to VI., consisting of the SUPPLY and LAYING in a prepared trench of THIRTY MILES of RIVETED STEEL PIPE in the following sizes :—60in., 54in., 51in., 48in., 42in., 36in., and 33in.

Plans can be seen and copies of specification, Tender, &c., obtained on or after January 20th, 1922.

In ENGLAND, from the Consulting Engineers, Messrs. St. George-Moore and La Trobe-Bateman, MM. Inst. C.E., 91, Victoria-street, Westminster, S.W. 1; and

In INDIA, from J. R. Coats, Esq., B.Sc., M. Inst. C.E., Chief Engineer to the Corporation of Calcutta, Central Municipal Offices, Calcutta.

The sum of £5 or Rs.75 respectively will be charged for each set of four copies of the contract documents, which sum will be returned on receipt of a bona fide Tender, prepared in triplicate.

Two copies of all Tenders, from wherever emanating, to be delivered at the offices of the Consulting Engineers in London at or before Twelve Noon on March 16th, 1922, when they will be officially opened in the presence of such tenderers as care to attend. The third copy to be dispatched by registered post on or before the same date, addressed to the Chief Engineer, Corporation of Calcutta, Central Municipal Offices, Calcutta.

Tenders to be in sealed covers and superscribed "Corporation of Calcutta, Tender for Steel Mains."

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenderers may submit separate Tenders for alternative proposals.

B. V. RAMIAH,
Secretary to Corporation.

Calcutta,
January, 1922. 7146

Corporation of Durban, Natal.

The Corporation of Durban, Natal, is prepared to receive TENDERS for the SUPPLY and DELIVERY free on board British port of :—

ONE 20-TON HAND-OPERATED OVERHEAD TRAVELLING CRANE,

to be approved by the Representative Engineers, Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W.

Specification, to be obtained from, and sealed and endorsed Tenders must be delivered to, the undersigned on or before 31st January, 1922.

The lowest or any Tender will not necessarily be accepted.

Applications for specifications must be accompanied by a deposit of Two Guineas per copy, which sum will be refunded on receipt of bona fide Tender.

By Order,
WEBSTER, STEEL and CO.,
Agents to the Durban Corporation.

5, East India-avenue,
Leadenhall-street, London, E.C. 7161

East Indian Railway.

The East Indian Railway Company is prepared to receive TENDERS for the SUPPLY and DELIVERY of—

NUTS (WROUGHT IRON),

as per specification to be seen at the Company's offices.

Tenders are to be sent to the undersigned, marked "Tender for Nuts," not later than Eleven o'clock a.m. on Wednesday, the 25th day of January instant.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By Order,
G. E. LILLIE,
Secretary.

Nicholas-lane, London, E.C. 4.
11th January, 1922. 7172

PUBLIC NOTICES

Government of Bombay.
BOMBAY DEVELOPMENT DIRECTORATE.
AMBERNATH INDUSTRIAL AREA.
SEWAGE SCHEME.

The Director of Development is prepared to receive TENDERS up to Twelve Noon on Wednesday, 15th March, 1922, for the CONSTRUCTION and RUNNING for six months of a SEWAGE INSTALLATION capable of dealing with the sewage and sullage water of an area containing 8000 people. The installation must be capable of dealing with about 1,10,000 gallons of liquid per day, and should not include the provision of sewers, which are being arranged for separately.

Tenders should be accompanied by earnest money of Rs. 500 (five hundred only), which will be returned to the unsuccessful tenderers and will be retained in the case of successful tenderer as part of the security deposit.

The Director of Development does not bind himself to accept the lowest or any Tender.

For particulars apply to the SUPERINTENDING ENGINEER, No. 3 Project Division, Directorate Buildings, Old Custom House-yard, Fort, Bombay.

N.B.—Ambernath is a new satellite town for the development of manufacturing industries and is situated on the G.I.P. Railway, 40 miles north-east of Bombay, India. 7140

Madras and Southern Mahratta
RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for—

1500 AXLE-BOXES FOR CARRIAGES AND WAGONS,

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, the 31st January, 1922, marked "Tender for Axle-boxes."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1,
10th January, 1922. 7173

Manchester Corporation Waterworks.

THIRLMERE AQUEDUCT.—FOURTH PIPE LINE.

The Waterworks Committee invite TENDERS for the LAYING and JOINTING of 54in. WELDED STEEL and other PIPES, the FIXING of VALVES and IRONWORK, the CONSTRUCTION of SUBWAYS under railways, &c., and other work connected with the Fourth Pipe Line from Thirlmere to Manchester, as follows :—

CONTRACT "A."—Ambleside to South of Kendal (about 8½ miles).
CONTRACT "B."—Kirkby Lonsdale to Lancaster (about 8½ miles).
CONTRACT "C."—South of Lancaster to River Ribble (about 4½ miles).
CONTRACT "D."—River Ribble to Horwich (about 6½ miles).

Printed specifications, schedules of quantities, and forms of Tender may be obtained on application to the Secretary, Waterworks Offices, Town Hall, Manchester, on receipt of a deposit of Five Guineas for each contract, which will only be returned to the tenderer provided that he shall have sent in a bona fide Tender and shall have returned the documents lent to him. Plans and drawings may be inspected on application to the Waterworks Engineer. Only a limited number of the drawings being available, these, excluding ordnance maps, will be lent to persons tendering in priority of application, on payment of the sum of Three Guineas, which sum will not be returned.

Sealed Tenders, endorsed as directed in the schedules, must be delivered at the Waterworks Offices, Town Hall, Manchester, not later than the 9th of February, 1922.

By Order,
THOMAS HUDSON,
Town Clerk.

Town Hall, Manchester,
29th December, 1921. 7085

PUBLIC NOTICES

London County Council.

TENDERS are INVITED for the MANUFACTURE, SUPPLY, DELIVERY, and MAINTENANCE of FOUNDRY PLANT for the Council's Tramways Central Repair Depot.

The specification, form of Tender, and other particulars may be obtained from the Clerk of the Council, County Hall, Spring-gardens, S.W. 1, on payment to the Cashier of the Council of a deposit of £2, which amount will be refunded on receipt of a bona fide Tender. Particulars of the work may be obtained on application at the County Hall before payment of this fee.

The drawing referred to in the specification can be inspected by appointment with the General Manager, L.C.C. Tramways, 23, Belvedere-road, S.E. 1, on production of a copy of the specification or a signed receipt for the fee paid in respect thereof.

Tenders must be addressed to the Clerk of the Council, and delivered at the County Hall, Spring-gardens, S.W. 1, not later than Twelve Noon on Tuesday, 31st January, 1922. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
7124 Clerk of the London County Council.

London County Council.
HAMMERSMITH PUMPING STATION.

TENDERS are INVITED for the CONSTRUCTION of an ENGINE-HOUSE in brick and concrete with slate roof, internal dimensions 150ft. by 50ft. by 40ft. high to the eaves, partly above and partly below ground, with OFFICE, STORE, WORKSHOP, and COOLING WATER TANK, together with SUPPLY, SUCTION and DELIVERY CULVERTS within the building and FOUNDATIONS for ENGINES, PUMPS and AUXILIARY MACHINERY; also the CONSTRUCTION of THREE PENSTOCK CHAMBERS outside the building, with connecting CULVERT and other subsidiary works. The work will be situated in the Metropolitan Borough of Hammersmith.

Persons desiring to Tender may obtain the drawings, specifications, bills of quantities, form of Tender, &c., on application to the Chief Engineer at 19, Charing Cross-road, W.C. 2, upon payment to the Cashier of the Council of the sum of £5. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specifications, and other contract documents may be inspected before the payment of the fee.

No Tender received after Twelve Noon on Tuesday, 7th February, 1922, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
7156 Clerk of the London County Council.

Tenders are Invited by the Government of New South Wales for the CONSTRUCTION of the SUPERSTRUCTURE and SUBSTRUCTURE of a CANTILEVER BRIDGE across Sydney Harbour from Dawes Point to Milson's Point, embracing a main span of 1600ft. in the clear, centre to centre of main piers, or 2600ft. centre to centre of anchor piers. The total length of bridge included in Tender is 3816ft., centre to centre of abutments. The deck of the bridge is to include four lines of railway, and a roadway 35ft. wide, between main trusses; and cantilevered outside the main trusses on the western side, a footway 15ft. wide, and on the eastern side a motor roadway 18ft. wide. Copies of specification, including plans, general conditions and schedule of quantities may be obtained on application to the undersigned.

To give any information required by tenderers, Mr. J. J. C. Bradfield, Chief Engineer, will be in London during June and July, 1922, address care of the undersigned.

Tenders in accordance with the specification must reach the Under Secretary for Public Works, Sydney, not later than 31st October, 1922.

AGENT-GENERAL
FOR NEW SOUTH WALES.
Australia House, Strand, London, W.C. 2,
December, 1921. 7086

The Danish State Railways invite TENDERS for the SUPPLY of about 831·3 TONS of
FISH-PLATE BOLTS, RAIL SPIKES, CLIPS, and LOCKING WASHERS.

Specifications and drawings can be obtained on payment of 10 Danish Crowns on application to L. Banekontor, Gl. Kongevej 1, Copenhagen B., where Tenders will be received not later than 3 p.m. on the 10th of February, 1922. 7157

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.
(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.

All communications to Head Offices,
H. W. REID, 85, Belgrave-road,
General Secretary. Victoria, S.W. 1.
Ex.

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PUBLIC NOTICES

Rangoon Municipality.

APPLICATIONS are INVITED for the APPOINTMENTS of TWO ASSISTANT ENGINEERS for the Public Works Department of the Rangoon Municipality.

AGE.—Preferably between 25 and 35 years.

QUALIFICATIONS.—Candidates should hold one of the following qualifications:—Membership or associate membership of the Institution of Civil Engineers, membership of the Institution of Municipal and County Engineers, or a degree in Engineering Science of any recognised University.

EXPERIENCE.—For one of the appointments it is essential that the candidate should have had considerable experience in the inception and execution of large water supply systems, scwerage systems, and sewage disposal works. For the other a general knowledge of municipal engineering, particularly with reference to road construction and maintenance on modern lines, surface water drainage and building construction.

SALARY.—The grade of the appointments is fixed at Rs. 600 to Rs. 1150 per mensem, rising by annual increments of Rs. 50 per mensem, plus a motor car allowance of Rs. 150 per month, but the initial pay of the appointment up to a maximum of Rs. 1000 per month plus car allowance will be fixed in accordance with qualifications and experience. The officer appointed will be eligible to subscribe to the Municipal Provident Fund after being confirmed in his appointment; subscriptions are payable at the rate of 8 1-3 per cent. of salary and an equal amount is contributed by the Municipal Committee. Compound interest is allowed according to amount earned by the Fund, usually 5 per cent. No exchange compensation allowance will be allowed. Other things being equal, preference will be given to those with approved war service.

Applications, stating age, present salary, if employed, whether married or single, and accompanied by copies of not more than three recent testimonials, will be received up to the 31st January, 1922, by the undersigned, from whom further particulars may be obtained.

OGILVY, GILLANDERS and CO.,
Agents for the Rangoon Municipality.
67, Cornhill, London, E.C. 3.
E. 2113. 7071

Siam State Railways.

NOTICE.

TENDERS are INVITED for the SUPPLY of ACCESSORIES for GOODS ROLLING STOCK.

Specifications and drawings may be obtained against payment of £2 from Messrs. C. P. Sandberg, 40, Grosvenor-gardens, London, S.W. 1.

Sealed Tenders, with the inscription "Tender for the Supply of Accessories for Goods Rolling Stock, 2464," must be forwarded to the undersigned, at whose office in the city of Bangkok, Siam, they will be received up to 2 p.m. on the tenth day of April, 1922, at which place and hour the Tenders will be publicly opened and read.

Right is reserved to reject any or all Tenders and to accept any Tender which, in the opinion of the undersigned, is to the best interests of the Siam State Railways.

PURACHATRA,
Commissioner-Gener l of State Railways.
Department of State Railways, Bangkok,
5th December, 1921. 7151

The Assam-Bengal Railway

COMPANY, LIMITED.

ASSISTANT LOCOMOTIVE SUPERINTENDENT.

The Directors are prepared to receive APPLICATIONS (by letter only) for APPOINTMENT as ASSISTANT LOCOMOTIVE SUPERINTENDENT in the Locomotive Department of the Company in India.

Candidates should be not more than 28 years of age, preferably unmarried, and must have had a thorough general and technical education at some recognised Engineering College. Preference will be given to those who have passed the Associate Membership Examination of the Institution of Civil Engineers or who hold an exempting degree. They must have served a pupilage or apprenticeship in a railway locomotive workshop or with locomotive builders of repute, and have had at least one year's experience in a locomotive drawing-office. Applicants should state whether they have had any experience of running shed work, firing, or "outside" work.

SALARY (including technical and overseas allowance), —Rs. 525 to commence, rising in accordance with the Company's rules.

TERMS.—A three years' agreement in the first instance, first-class free passage to India and home again on satisfactory termination of services.

The selected candidate will be required to pass a strict medical examination before final appointment.

Letters of application, giving candidates' age (whether married or single), details of general and technical education, training and subsequent experience (in chronological order), with dates accompanied by copies only of testimonials, Army certificates, &c., should be addressed to the undersigned not later than 23rd January, 1922.

By Order of the Board,
OSWALD I. MILNE,
Secretary.

11th January, 1922,
Bishopsgate House,
80, Bishopsgate, E.C. 2. 7175

The South Indian Railway Company

PANY, Limited, are prepared to receive TENDERS for the SUPPLY of :—

1. STEEL BEARING PLATES.
2. SCREW SPIKES.
3. LAMPS AND GLASS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Steel Bearing Plates," or as the case may be, must be left with the undersigned not later than Twelve Noon on Wednesday, the 25th January, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1, 2, and 3.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 2, Victoria-street, Westminster, S.W. 1.

W. B. REYNOLDS,
For Managing Director.
91, Petty France, S.W. 1,
11th January, 1922. 7177

Wincanton Rural District Council.

TEMPLECOMBE WATER SUPPLY.

CONTRACT No. 2.

The above Council invite TENDERS for the SUPPLY and ERECTION of PUMPING PLANT in connection with the above works at the proposed Pumping Station situated at Milborne Wick, in the County of Somerset.

The plant comprises oil engine and three-throw well pump, together with the necessary head gear, pump rods, &c., complete, capable of raising 6000 gallons of water per hour to a height of about 220ft., the whole to be in accordance with the specification prepared by the Engineers, Messrs. A. P. I. Cotterell and Edson, of 17, Old Queen-street, Westminster, S.W. 1.

Copies of the plans and specification and form of Tender, &c., may be obtained from the Engineers on or after the 16th January, 1922, by intending contractors on payment of the sum of Two Guineas, which will be returned on receipt of a bona fide Tender and all other documents supplied.

Tenders, on the form provided, enclosed in sealed envelopes, must be delivered to the undersigned and endorsed "Templecombe Water, Contract No. 2," not later than 10 a.m. on the 6th February, 1922.

Contractors will be required to provide securities for the due performance of the contract under Section 174 (4) of the Public Health Act, 1875.

The Council do not undertake to accept the lowest or any Tender, but reserve freedom of action.

By Order,
E. N. MARTIN,
Clerk to the Rural D.....ict Council.
Wincanton, Somerset,
7th January, 1922. 7139

PUBLIC NOTICES

Port of London Authority.

WANTED, DRAUGHTSMAN, with general Building Construction experience; able to make finished drawings from rough sketches of all classes of buildings, roadways, and drains.—Forms of application can be obtained from the CHIEF ENGINEER, 109, Leadenhall-street, E.C. 3. 7147

SITUATIONS OPEN

WANTED, ENGINEER for Blast-furnace Plant. Must be experienced with Electric Power.—Address, stating age, experience, and salary required. 7095, The Engineer Office. 7095 A

WANTED, GENTLEMAN, to Reside in Far Eastern country, as REPRESENTATIVE of a Steel Manufacturing Company. Applicant must be of good education and presence, sound commercial experience, and preferably have had practical experience in the manufacture and use of High-grade Steels.—Address, P4665, The Engineer Office. P4665 A

ASSISTANT ENGINEER REQUIRED for Estimating and Contracts Department. Public school and university man preferred. Practical training and knowledge in design of Centrifugal and Turbine Pumps essential. Applicant should be energetic and fully experienced in pushing sales.—Apply, stating age, full experience, and salary required, to Messrs. W. H. ALLEN, SONS and CO., Ltd., Queen's Engineering Works, Bedford. 7091 A

ENGINEERING SALESMAN WANTED for Far East. Must have thorough practical knowledge of Internal Combustion Engines. Single man with good education.—Address, giving full details of experience and salary required, 7166, The Engineer Office. 7166 A

MANUFACTURERS of STEAM WAGONS and TRACTORS are OPEN to CONSIDER APPLICATIONS for the position of SALESMAN. Applicants must be able to furnish undeniable references as to character and capacity and state age, experience, and remuneration expected.—Address, 7113, The Engineer Office. 7113 A

REQUIRED, an ENGINEER for the South of England, thoroughly conversant and capable of Designing Bakers' Ovens, to Take Charge of Small Works; excellent opening. State age, experience, in confidence.—Address, P4667, The Engineer Office. P4667 A

REPRESENTATIVE REQUIRED for South Wales by Firm of Pump Manufacturers. Commission only.
Address, P4670, The Engineer Office. P4670 A

WANTED, ASSISTANT MECHANICAL DRAUGHTSMAN (23-24) in London; get out working drawings, &c. Overtime might do.—Address, P4662, The Engineer Office. P4662 A

WANTED, DRAUGHTSMAN, with Experience in Centrifugal Pumps and General Engineering Work, for works in South of England.—Address, 7153, The Engineer Office. 7153 A

WANTED, Good Quick MECHANICAL DRAUGHTSMAN, used to scheming, and preferably with some electrical knowledge. Prospects good to the right man.—Apply by letter, stating experience and salary required, to the BRITISH ELECTRIC TRANSFORMER CO., Export Department, Hayes, Middlesex. 7155 A

A FIRST-CLASS DRAUGHTSMAN WANTED for Electrical Engineering Works in London. Must have had a comprehensive experience in the design of up-to-date Switchgear and be capable of exercising initiative. A thorough works training and good electrical knowledge is essential. All applications will be treated as strictly confidential.—Address, stating age, experience, and salary required, 7081, The Engineer Office. 7081 A

DESIGNER WANTED, Used to Rotary Petrol Engines and General Motor Car Design, for good progressive position. References, &c., required. Also LADY TRACER.—Address, P4708, The Engineer Office. P4708 A

DRAUGHTSMAN, Familiar with Calculations and Design of Pumps, for important firm in France. Tabulate training, experience and salaries; must know French.—Address, P4677, The Engineer Office. P4677 A

DRAUGHTSMAN REQUIRED for Scientific Instrument works; must be capable of carrying out experimental work and the preparation of drawings. He must have a good knowledge of engineers' requirements. State full particulars and salary required.—Address, P4640, The Engineer Office. P4640 A

DRAUGHTSMAN WANTED, First-class Man, with good experience of High-speed Steam Engines and General Engineering Work. Age 28-40 years. Thoroughly experienced men only need apply. State age, salary, references.—Apply, EASTON and JOHNSON, Ltd., Taunton. 7135 A

LEADING DRAUGHTSMAN REQUIRED for Universal Slow and Drop Valve Steam Engine Design; capable of taking full charge of department and working out general and detailed designs in accordance with latest developments.—Address, stating age, experience, and salary required, 7064, The Engineer Office. 7064 A

MECHANICAL DRAUGHTSMAN WANTED for Mining and General Machinery and Railway Plant. Knowledge of Spanish desirable.—Write, stating age, experience, and salary required, to "M. D.," c/o Street's, 30, Cornhill, E.C. 3. 7131 A

WANTED, First-class FOREMAN for Scientific Instrument manufacture, used to the control of men. Must have a sound knowledge of Machine Tools and the production of first-class precision work. State full particulars and salary required.—Address, P4641, The Engineer Office. P4641 A

FOREMAN REQUIRED for Small Tool Works manufacturing principally Milling Cutters.
Applicants must have had thorough practical experience and a knowledge of the manufacture of Small Tools from the blank to the finished article.
An exceptional opportunity for the right man.
Address, with full particulars, P4647, The Engineer Office. P4647 A

FITTER, with Experience Large Steam Engines, Pumps, &c., REQUIRED for Gold Mine in West Africa.—Address, stating age, experience, with copies of testimonials, 7107, The Engineer Office. 7107 A

COST CLERK WANTED for Sea Wall and Workshop erection contract at Lagos, Nigeria. Must also be experienced in correspondence and general office routine. Salary £55 per month, with free furnished quarters, free first-class passage out, four months' leave on full pay and free passage home for each 18 months of satisfactory service.—State full particulars, age, and when at liberty, to Box 6014, c/o Brown's, 39, Tothill-street, S.W. 1. 7138 A

SITUATIONS WANTED

ADVERTISER (35) SEEKS POSITION: Experience switches, crossings, lay-outs, steam, petrol locos., also pumps; 7 years charge D.O., 2½ charge small works; good references.—Address, P4629, The Engineer Office. P4629 B

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For continuation of Small Advertisements see page iii

Iron, Steel, Coal and Engineering Trades in 1921.

No. II.*

SHEFFIELD.

WHEN 1920 came to a close one of the features of that period was the wholesale cancellation of orders, but with the opening of 1921 there was evidence that new business was beginning to flow again, though the stream was a very thin one and had the appearance of a re-dishing of some of that which had been cancelled. On the whole, however, the outlook was a very anxious one, though some of the firms were pushing on with extensions. For instance, Davy Brothers, Limited, the engineers, were building a large works at Darnall, and the new Ivanhoe Steel Works of Henry Rossell and Co. were nearing completion at Meadow Hall. The greatest sufferers at this time and, indeed, throughout the year, were manufacturers of high-speed steel. North Lincolnshire developments were still proceeding in January, but unfortunately had subsequently to be suspended for obvious reasons—at least, most of them. For the Appleby Iron and Steel Company, owned by the United Steel Companies, Limited, Davy Brothers, however, completed during the year a hot-metal mixer of 500 tons capacity. Other extensions in that district have included a large plate mill for the Appleby concern, a cogging and slabbing mill for the Redbourn Hill Iron and Steel Works, and a new tilting furnace for the Frodingham Iron and Steel Works. There was a fair amount of activity among builders of rolling stock, including locomotives, and early in February a big aerodrome on the outskirts of the Nottinghamshire town of Hucknall was sold by the Government to the Mansfield Engineering Company, Limited, with the object of its conversion into a works for the building of colliery and railway wagons, and that at Sherburn, near Selby, was sold for a similar purpose to Thomas Burnett and Co., Limited, wagon builders, of Hexthorpe, Doncaster. Cravens, of Sheffield, were in February turning out some smart-looking composite carriages for the Ebbw Vale line, had in hand a number of "sleepers" and restaurant cars for Siam, and were expecting to learn something definite about the huge Rumanian rolling-stock repairing contract—though, as a matter of fact, that particular business had not been "landed" by the end of the year.

Apart from those things, however, industry was literally struggling for existence, and in the middle of February one of the leading manufacturers in Sheffield declared that in the thirty-six years he had been in the steel business he had never known anything to approach the conditions then prevailing. Nevertheless Clayton Wagons, Limited, of Lincoln, secured an order from the Egyptian State Railways for a large number of 30-ton bogie oil tank wagons, as well as for the repair of 3000 wagons for various home railways, and the re-conditioning of a number of main line corridor cars for the Great Northern. At the end of the first quarter Cravens, of Sheffield, were carrying out important extensions, including large machine shops, saw-mills and erecting shops, equipped with the latest labour-saving devices. About this time an interesting development in colliery circles was the purchase from Earl Manvers by the Bolsover Colliery Company of the lease of 7000 acres of coal on the Thoresby Estate in the country known as the "Dukeries." In addition to its other properties, the Bolsover concern then had ready for working, its new Clipstone mine, which it was estimated would bring up the colliery's output to about 5,000,000 tons a year.

Heavy Engineers Fairly Active.

The close of March found the gloom lifting from the armament shops, for beside the Japanese armour-plate contract for 7600 tons, there was talk of good ordnance orders from Spain, and a belief prevailed that, in spite of a demand for "cutting down" the Navy, it would not be very long before important contracts would be placed by the Admiralty. This, of course, proved to be correct, though, as already explained, the orders were in the end suspended or cancelled. Hadfields had long had under consideration the possibility of developing the use of the company's system of manufacture and sale of its special products in the United States, and the announcement was then made that with that object in view the company had joined with the American Clay Machinery Company, of Bucyrus, a licensee of Hadfields, in forming the Hadfield-Penfield Steel Company, in which the Sheffield concern held a substantial interest.

At the height of the national coal strike manufacturers were experiencing extreme difficulty in keeping works going, even partially, and one by one they were closing down entirely, including most of the largest. Nevertheless, heavy engineers maintained fair activity on the whole, Spain and Japan both being in the market. A considerable amount of constructional work, too, was in hand for South Wales, and one firm, the Brightside Foundry and Engineering Company, Limited, made an 87-ton ingot mould for the Darlington Forge Company, this being the largest mould ever made in Sheffield and conveyed out of the city by rail. Not very long before that event another Sheffield firm of heavy engineers—Davy Brothers—produced a similarly huge casting intended for new plant being erected in North Lincolnshire, and it, being too wide for transit by rail, was conveyed almost all the way by canal and river. In May, the Park Gate Iron and Steel Company announced that good progress was being made with the new 24in. section mill, and a new 3000-kilowatt turbo-alternator had been installed at the works to make use of the increased amount of exhaust steam then available. In the meantime, however, operations in North Lincolnshire had been brought practically to a standstill, and where work was maintained in that and the Sheffield areas it was largely by means of the installation of oil fuel burners in place of coal. A very large number of these installations was made, but at the end of the coal strike, although many people fancied the success of oil fuel would give it a permanency in the iron and steel district, there was a general reversion to the ordinary furnace. June brought with it rather more hope, a few good orders having been booked, beside which Sheffield was expecting to benefit by the huge contract placed with the Metropolitan-Vickers concern in Manchester by the Victorian Government. The order was for generating plant of 50,000 kilowatts, the figure mentioned being in the region of £300,000, and it was thought that some of the turbo-alternator requirements would be filled at Vickers' Sheffield Works.

Lord Aberconway's View.

Lord Aberconway, speaking at the close of the month, on the occasion of the annual meeting of John Brown and Co., expressed faith in the ability of industry to recover, but added that at the moment he considered the position was the most serious since he began his business career. He spoke of the company's new tire, axle and other railway material-making plant in North Lincolnshire, of the many improvements carried out at Clydebank, such as a new platers' shed, power-house, &c., and of the company's determination to equip its collieries with the last word in coal-cutting machinery and other facilities for increasing the rate of output. By the end of July the steelworks in this part of the country were showing signs of returning activity and just over the Rotherham side of the border, Steel, Peech and Tozer, Limited, whose Siemens and Bessemer steel melting departments had been idle for many months, announced that preparations were being made for resuming operations; but one of the disappointing features of the situation about this period was the decision to close down, for the time being at all events, the works of William Jessop and Sons, control of which had been acquired by the Birmingham Small Arms Company. On the other hand, Cravens—now controlled by John Brown's—booked an order for no fewer than forty-five oil-tank wagons of 14 tons capacity each, and Clayton Wagons, Limited, of Lincoln, were just completing for the Brighton line a new type of third-class Pullman car, different from anything of the kind previously built.

With the advent of September, the finishing touches were being put to a couple of batteries of very modern coke ovens of the Koppers type for the United Steel Companies, Limited, at that concern's Rother Vale Collieries at Orgreave, near Rotherham, there being fifty-four ovens in each battery. The installation included a tar distillation plant, and a pipe-line was laid so that surplus gas from the ovens might be conveyed to the mains of the Sheffield Gas Company. In the same month a considerable degree of satisfaction was being felt in light steel circles in Sheffield at the fact that the deputation, headed by Mr. Arthur Balfour, which had been on a visit to the States with the object of endeavouring to call attention to the hardships that the proposed American tariffs would impose on Sheffield firms trading with America, had been permitted to address the Finance Committee of the United States Senate and apparently had met with remarkable success. It was in the third quarter, too, that the Brightside Foundry and Engineering Company completed for Hadfields, Limited, a very fine 28in. reversing mill, comprising a set of cogging and finishing rolls, and also a 30in roll lathe for the Appleby Iron and Steel Company. The Staveley Coal and Iron Company was carrying out developments about that time, including sinkings to the black shale seam at Markham Colliery, and at a pit near to the Devonshire Works, a new washery, further sulphuric acid chamber plant, an additional forty coke ovens with recovery plant—making 250—tar-macadam plant capable of dealing with about 2000 tons of blast-furnace slag per week, and other things. Early in the next month came the announcement that the firm of Thos. W. Ward, Limited, had purchased from the Admiralty for breaking-up a block of 118 battleships, cruisers and destroyers, the work of dismantling the boats being undertaken at the firm's twelve yards.

Cammell Laird and Co. in India.

Ingleby and Co., Limited, electric dynamo and motor manufacturers, in October opened new works on a site of approximately 10 acres adjoining Old Lane, Beeston, Leeds. These works were intended for the manufacture of electric motors for industrial purposes, ranging from ½ to 200 brake horse-power. This month, too, was notable for the announcement that Cammell Laird and Co., in conjunction with Bird and Co., of Calcutta, had registered at the latter place the United Steel Corporation of Asia, Limited, with a capital of 20 crores of rupees. On the terms of the scheme Cammell's were to design, erect and staff the works, which are to have an ultimate output of from 600,000 to 700,000 tons of pig iron and 450,000 tons of finished steel per annum. Prominent in the operations of Edgar Allen and Co. was the production for Sweden of what was claimed to be one of the largest lay-outs in manganese steel constructed in this country, and the same firm has erected the largest rock crushers of the gyratory type ever made in Britain. Speaking generally, however, the industrial situation was very discouraging, trade responding exceedingly slowly to the efforts to bring about a recovery, and when December came hope of any improvement that year was abandoned by most people. There were still a few bright spots; one of them, perhaps, being the bid made by a well-known firm of saw manufacturers to out-manœuvre the United States in the matter of large circular saws with inserted teeth, and another the building by the Yorkshire Engine Company, for Spain, of one of the largest locomotives constructed in this country, being of a special type. A feature at the Park Gate Iron and Steel Company's works was the installation of a 400-ton mixer.

As the close of the year approached the outlook seemed to brighten a little, and in North Lincolnshire five furnaces had been put into blast with the prospect of two or three others re-starting after the turn of the year. Vickers' report for the year to December, 1920, showed net profits of £541,261, which was about one-half of the average annual profits for the previous four years, and another interesting item of armament company news was contained in a series of directorate changes announced by Thos. Firth and Sons, the chief movement being that Mr. J. Rossiter Hoyle, joint managing director with Mr. F. C. Fairholme, relinquished that position, but retained a seat on the board, Mr. Fairholme becoming sole managing director. A number of interesting contracts, beside those already mentioned, have been filled by Davy Brothers, including hydraulic presses for Japan, Spain, Belgium, Australia and for the British Government, a 40in. slabbing mill train for the Appleby Iron and Steel Company, a complete 36in. rail and section mill for Baldwins at Port Talbot—probably the most up-to-date plant of its kind in existence—a 14in. bar mill of improved design for Brown Bayley's steel works, Sheffield, a 12in. double two-high rolling mill for the Tinsley Rolling Mills, Ltd., and a number of powerful bloom and billet shears for steel works at home and abroad. Another important installation recently supplied was an up-to-date tire-making plant for the new Penistone Steel Works of Cammell Laird and Co., consisting of a 2500-ton "Davy" high-speed tire slabbing and punching press, tire-cogging mill, tire-finishing mill and tire-making press.

NORTH OF ENGLAND.

WITH the opening of 1921 it was borne in on the minds of manufacturers in the North of England that the breaking point in the matter of high prices had been reached, and that if trade, especially overseas, was to be recovered in any appreciable quantity, a tremendous effort would have to be made to reduce costs of production. As the first quarter progressed a very gloomy view began to be taken. The works on the North-East Coast were fairly well employed, but no new business was coming forward. The shipbuilding industry was suffering severely from cancelled orders for merchant tonnage and passenger boats, one firm alone having had as many as fourteen contracts treated in that way, shipowners paying the fines rather than completing the business. Makers of iron and steel began to reduce their rates in the hope of inducing consumers to come on to the market, but at that time the continental makers were hopelessly outbidding home producers, and matters all round went from bad to worse. On the Tyne alone in January fully a hundred vessels were laid up idle. Meanwhile, the downward trend in iron and steel prices continued, though, apparently, to little practical purpose; nevertheless, before the end of the month, two of the blast-furnaces at the Acklam Ironworks, Middlesbrough, belonging to the North-Eastern Steel Company, were put into commission again after a period of twenty-one months, the stoppage having been necessitated by the plans for reconstructing the steel works. That, however, could not be taken as any criterion of the situation, which was such that one after another ironworks were partially or entirely closed down and the foreign ore trade was all but at a standstill. One significant feature of the February ascertainment was a sharp drop in the wages of workers in the North of England iron and steel trades, and an interesting report early in March was that the establishment of a new river line had been decided on by the Tees Conservancy Commissioners—a step rendered necessary by the erection of new works at Greatham Creek, on the north side of the river. The scheme provided for a navigable channel 1000ft. wide.

The Shipbuilding Slump.

The national coal strike in April was, of course, the

* No. I. appeared January 6th.

crowning disaster, but a gratifying aspect of the preceding month's trade returns was an improvement in the exports of manufactured iron and steel from the Cleveland area, chiefly attributable to better buying from the Far East. On the other hand, the second month of the coal strike found industry everywhere in the North being strangled and unemployment reaching an alarming level. The iron and steel trades were at a complete standstill, shipyards were closing down indefinitely, and by the end of April the last two furnaces which Bolckow, Vaughan and Co. had kept running in slack blast at their South Bank works were damped down. The shipbuilding slump on the Wear was plainly manifest by the fact that only one vessel, of 9475 tons, was launched in June, and that for the first six months of last year only thirteen boats, with an aggregate tonnage of 70,902, were launched, compared with thirty-five vessels and a tonnage of over 160,000 for the corresponding period of the year before. And it was not only on the Wear, of course, for the same deplorable conditions prevailed almost everywhere. July was rather fully occupied in getting industry into action again after the strike, but although the feeling was more hopeful, trade continued very bad indeed, and even the persistent fall in iron and steel prices did little to remedy matters—in fact, it had the effect of causing consumers to hold off the market for still better prices. The same month the Ashington (Northumberland) Coal Company served notice to its men that within three months it was proposed to close down the Ellington pit, one of the company's newest pits, giving employment to about 1100 workers.

Gradually the position began to improve, but very, very slowly, and at the beginning of the third quarter the East Coast hematite pig iron trade was extremely quiet, no furnaces having been put into blast again, whilst most of the iron-producing firms declared they could not afford to smelt Cleveland ore at the prevailing price. Matters revealed a tendency to improve in the shipyards, but a retarding influence was the joiners' strike, which sent large quantities of repair work abroad. A bright feature in the coalfield was the fact that the Seaton Delaval Coal Company was, by July, engaged on a big project for increasing the output and developing the colliery, at a cost of something over half a million sterling. Extensive new machinery was erected and coal taken on the surface from the Relief pit to New Delaval was carried underground and drawn at the New Delaval shaft.

Vessels Sent Abroad.

By August the price of fuel and production costs generally had fallen so appreciably that ironmasters were encouraged to put further furnaces into blast, one of the first firms to resume the production of hematite pig iron being the Normanby Ironworks Company, Middlesbrough, where two furnaces were blown in. But adding to these the furnaces already making Cleveland and basic iron, the total was only eleven out of the normal number of seventy-two. The effect of the settlement of the joiners' strike was not so marked on the Teesside and the Hartlepools as in the Tyne shipyards, for most of the work in the two first-named was either done by apprentices or the vessels were sent abroad to be finished, whereas on the Tyne and Wear some of the yards were said to have as much as two years' work in hand. A rather notable event—and a regrettable one—in September was the dismantling of the Brotton mines, which, since the early 'sixties, had yielded the richest ore from the Cleveland strata. They were, however, on the point of exhaustion when the coal strike occurred. On the whole, the month was characterised by a very much more hopeful feeling in trade circles, though everyone recognised that the path was still strewn with enormous difficulties. Works closed down during the coal strike were gradually re-opening, amongst the number those of Palmer's Shipbuilding and Iron Company at Jarrow, while the Skinningrove people were making preparations for a re-start, and it was expected that several additional furnaces would be put into blast. Then the outlook for shipbuilding brightened appreciably, Tyne builders receiving instructions from the Cunard Line to proceed with work on three vessels, viz., the Laconia, at Swan, Hunters, Wallsend, the Audania, at Hawthorn, Leslies, Hebburn, and the Anconia, at the Walker naval yard, in addition to which the Mauretania arrived for repairs and conversion into an oil-burner at the yard of her builders, Swan, Hunter and Wigham Richardson, Limited.

At that time, too, good progress was being made with the new works under erection on the north bank of the Tees at Billingham for Synthetic Ammonia and Nitrates, Limited—a company formed under the auspices of Brunner, Mond. The works are to cover an area of about 850 acres, with a river front of 1650 lineal feet. One must pass over the period, about mid-September, when so much satisfaction was expressed on the Tyne, as on the Clyde, and in Sheffield, that the Admiralty was giving out contracts for four battle-cruisers of the Hood type, costing about £8,000,000 each, because, as everyone now knows, the Conference at Washington brought about the suspension, or cancellation, of those orders; but it must be recorded that the moral effect of this disappointment in armament and shipbuilding circles was distinctly adverse to trade generally, the forward movement, which, up to that time had been slowly developing, suddenly ceasing, and before October had advanced very far Eltringham's shipyard and engine works at Willington-on-Tyne had to be temporarily closed down. Activity in the ironworks, however, blazed up again fitfully, and further furnaces were blown in, but comparatively little actual business resulted, buyers exercising the greatest possible caution against committing themselves ahead. During October, details were avai able of a scheme for the establishment of the Walbottle Coal and Fireclay Company. New and costly electrical equipment was to be installed, and it was estimated that the ultimate rate of carbonisation would be as much as 2000 tons per week. Just at the end of the month the Cunarder Berengaria, formerly the German Imperator, arrived at Armstrong's Walker naval yard to be overhauled and re-fitted as an oil-burner.

Encouraging News.

As the close of the year approached an encouraging piece of news came to hand. In face of strong foreign competition, the Cleveland Bridge and Engineering Company, of Darlington, secured contracts from the Union Public Works Department, South Africa, for the steel work of no fewer than twenty bridges, the weight of the forty-five spans required being approximately 4400 tons and the cost £200,000. This contract was the more gratifying in that it was obtained in open competition with leading firms in France, Belgium, Canada and the United States, and in December there was talk of the Cleveland iron and steel export business showing signs of a much-needed revival. A big scheme of extension is in contemplation by the Teesside Bridge and Engineering Works, Limited, Cargo Fleet, Middlesbrough, and a large area of land adjoining the works is to be purchased from the Middlesbrough Corporation. The firm mentioned recently secured a big contract for material previously manufactured in India by native labour, and in order to enable it permanently to manufacture this particular speciality it is proposed to build another foundry, while, as the local steel trade revives, it is intended to re-start work in No. 1 foundry. Swan, Hunters have booked an order for a couple of steamers for the Canadian lakes, and Dorman Longs, of Middlesbrough, as the result of their union with Braithwaite and Co., the West Bromwich and Newport (Mon.) engineers, have obtained a valuable contract for supplying and laying some 60 miles of double pipe line for the Bombay Corporation. The requirement will include 70,000 tons of plates, which at an output rate of about 500 tons a week, should cover the next three years. A week or so ago it was reported that Walter Runciman and Co., Limited, had purchased four 10,000-ton steamers being built on the Tyne and the Wear, for delivery next year. Two of these vessels are on the Northumberland Shipbuilding Company's stocks on the Tyne, and the other two at Doxford's on the Wear.

When Things will Mend.

Speaking at the shareholders' meeting in Manchester at the close of July, the chairman of Armstrong, Whitworth, Sir Glynn West, said that, bad as things were, the company still had a great deal of work in the shipyards and shops, and he felt sure that the acceptance of the principle that wages must vary with the cost of living would greatly help the country to secure further orders in the markets of the world. Regarding shipbuilding, Sir Glynn's opinion was that the gradual replacement of steam engines by internal combustion engines would ultimately lead to the building of a new type of ship. In other departments large contracts were being negotiated, the directors having then recently obtained two important orders in Nigeria, which there was reason to believe would be followed by others. At one time during the year it was reported that Armstrongs had formed certain subsidiary companies to operate newly acquired mining interests in South America.

Harbours and Waterways in 1921.

No. II.*

BRITISH DOMINIONS AND INDIA.

Canada.

At Vancouver the first section of a scheme of harbour development has been commenced during the year. This includes the construction of a large pier at Burrow Inlet having a depth of 45ft. alongside the outer berths. The structure is to be of reinforced concrete cylinders filled in behind with sand and gravel filling. The superstructure will carry extensive double-storey transit sheds and warehouses. The total cost of the scheme is estimated at £1,500,000.

The construction of a private graving dock and repair yard for a firm of shipbuilders has also been commenced. These works are estimated to cost £1,000,000.

At Esquimalt, B.C., the construction of a large graving dock by the Dominion Government is in hand. The contract for this work, which will cost nearly 4½ millions of dollars, was let early in the year, and work was commenced in March. The dock will be 1150ft. in length, 120ft. wide, with a depth of 40ft. over the sill. Floating caissons will be used for closing the entrance, and for the internal compartments, of which there are to be three. The site chosen for the dock is at Skinner's Cove, 4 miles from Vancouver. An ambitious scheme for the improvement of the St. Lawrence navigation between Montreal and the Lakes at a cost of £50,000,000 has been considered by the International Waterways Commission. The scheme, if carried out, would, in addition to providing a navigable waterway 25ft. in depth for ocean-going vessels between Montreal and Lake Ontario, enable 5,000,000 horse-power of electric energy to be obtained from hydro-electric plants situated at various points along the route. The fall from Lake Ontario to Montreal is 220ft., and it is proposed to overcome it by the construction of nine locks. The total length of the navigation would be 181 miles, of which 33 miles would be canal, 40 miles lake channels, and 108 miles river navigation. For an extra expenditure of about 4 millions sterling a depth of 30ft. could be provided throughout the navigation. The project now before the public is a modification of one put forward in 1920 by a New York engineer, Mr. Cooper, which he estimated to cost 1500 millions of dollars. Since the earlier scheme was published, the idea has been investigated by Canadian Government engineers and engineer officers of the U.S.A., who have prepared the revised scheme now being considered by the International Waterways Commission. At Montreal, important additions to the cold storage and transit shed accommodation of the port have been made, and large additiors to the mechanical equipment are in hand. The construction of the Welland Canal continues to make progress and during the year additional contracts for certain sections were let. At Toronto the Harbour Commissioners in conjunction with the Dominion Government are engaged on a big development scheme, which, when completed, will have cost about 25,000,000 dols.

Australia and New Zealand.

The Government of New South Wales during the year 1921 brought into operation a big scheme for developing the grain export trade of the State. It constructed at Sydney a grain storage building and elevators, which is one of the largest of its kind in the world. The building is of reinforced concrete, and has a capacity of 6½ million bushels. Railway trucks are unloaded at the maximum rate of 80,000 bushels per hour, and the silos discharge grain into ships lying alongside the granary at berths having 35ft. depth of water at low tide. In connection with these terminal shipping facilities at Sydney the Government has also provided country collecting, storing and elevator plant at seventy-two centres in the State, to which grain is brought by the farmers, stored and loaded in bulk into freight wagons on the railway for transport to Sydney. Although the whole of the works is not yet completed in every detail, the plant was in operation during the past harvest season. The total expenditure on the project is estimated to be about 3 millions sterling. The scheme has resulted in a considerable speeding up of the transport of grain from the farmer to the overseas shipping and in a reduction of the costs of handling and transit.

Another important work in connection with Sydney Harbour is the improvement of the Western Channel, where a depth of 40ft. at L.W.O.S.T. throughout its length was obtained during the year. The work of deepening over the full intended width of 700ft. is nearing completion.

At Melbourne a scheme of port development which has been in abeyance since 1915 revived, and work is again in progress. The construction of new docks having a depth of 32ft. is contemplated. The new harbour works at Burnie, a port on Bass Strait, in Northern Tasmania, were inaugurated by the Governor in March. In New Zealand improvements proposed at Gisborne Harbour will cost £1,000,000; the deepening of Tauranga Harbour to 23ft. is in contemplation, and the construction of a new deep-water wharf at Wellington is in hand.

South Africa.

Capetown.—The extension of the harbour works in Table Bay and the provision of port facilities in accordance with the scheme sanctioned by the Union Government made good progress during the year, but the work was to some extent retarded by the financial depression which is particularly marked throughout South Africa. The scheme of works now in course of execution includes an extension of the breakwater, widening of piers, reconstruction of quays, and the provision of new equipment such as coal bunkering facilities, cold storage, grain elevators and oil storage and bunkering plant. The grain storage and elevator, the construction of which is in hand, will have a capacity of 30,000 tons, the reconstruction of No. 7 quay is nearing completion, and additional cold storage sheds have recently been put into use. In connection with the East Pier, which is to be widened, berthing accommodation for vessels up to 786ft. in length and drawing 40ft. is to be provided. The total cost of the works in hand and sanctioned is estimated at about £1,600,000. A Com-

† No I. appeared January 6th.

mittee appointed by the South African Government recently reported on the further works desirable for the development of Table Bay Harbour. Its estimate of the cost of the proposals, which apparently include certain works provided for in the earlier schemes and not yet begun or completed, is 3½ millions sterling. Among the additional works proposed are the construction of a graving dock, reclamation of land, the widening of the South Arm and the extension of the breakwater by 1500ft.

Durban.—The improvement of the harbour at a cost of a million sterling is proposed. Work in connection with the provision of oil storage and bunkering facilities is in hand, and a grain elevator of 42,000 tons capacity is now being erected. This latter work is a part of the programme of the South African Government to develope the grain exporting trade of the Union by cheapening the cost of handling and expediting shipment.

Port Elizabeth.—Works for the improvement of the outer harbour are in progress.

East and West African Ports.

During the year several important contracts for harbour construction in East and West Africa were placed in the hands of British contractors. At Kilindini, near Mombassa, Messrs. Pauling and Co. are constructing for the Colonial Government a deep-water pier and other harbour works to cost over a million sterling. Sir W. G. Armstrong, Whitworth and Co. have secured the contract from the Nigerian Government for the extension of Lagos harbour works. The work was commenced early in the year. The contract for the construction of a deep-water harbour at Takoradi, near Secondi, on the Gold Coast, was placed in the hands of Messrs. Stewart and Macdonald. The works are estimated to cost £1,600,000, and will take 3½ years to complete. At Zanzibar harbour extension works to cost £250,000 are proposed.

Although outside the British Empire, two other West African harbour contracts may be mentioned here; they are Loanda and Lobito, both ports in Portuguese West Africa. Messrs. Pauling are carrying out the latter, and Messrs. Sir J. Norton Griffiths and Co. have the contract for the works at Loanda.

India.

Calcutta.—The Commissioners of the port of Calcutta were about to begin the carrying out of their scheme of dock extension in Garden Reach when the Great War brought about a postponement of their plans. The actual construction of the new docks, which will be known as the King George Docks, was commenced in March, 1920. The work is now well in hand, and it is expected to be completed in about five years. The site of the docks is on the bank of the river Hughli, in Garden Reach, five miles below Howrah Bridge. The water area will be 190 acres; there will be 25,000ft. of deep-water quay frontage, which will provide berthing accommodation for thirty-five vessels of far larger size than can be accommodated in the Commissioners' existing docks at Kidderpore.

Bombay.—At the moment there are no large works of harbour extension in the making at Bombay, but a good deal of work is being done by the Port Trust, in conjunction with the Development Directorate, in relieving the congestion in the central business quarters by the construction of a new cotton depôt on the Mazagaon Seuree Reclamation. When this is complete the Colaba cotton green and the go-downs in the neighbourhood will be abolished, and incidentally the Bombay-Baroda railway terminus will be removed from Colaba. The new go-downs on the reclaimed area are, in the first instance, to be 178 in number, each 110ft. by 43ft. by 30ft. high, and constructed of reinforced concrete. This depôt will store the whole of the cotton coming into Bombay. The Port Trust has also recently completed a large scheme of workpeople's dwellings near Antop Hill, four miles from the business centre of the city. Work is also in hand at Bombay in connection with facilities for oil storage and bunkering. Although the Trustees have no big programme of dock or harbour construction actually in hand, a project embracing extensions and developments on a large scale is now under consideration.

The most important work, of interest to the harbour engineer, now in progress at Bombay is the Back Bay Reclamation, work on which has recently been commenced. By means of a sea wall over four miles in length 1145 acres of foreshore in Back Bay will be reclaimed and made available for industrial and other forms of development. The sea wall is founded on the foreshore at or below low-water line and consists of a rubble mound with heavy concrete superstructure and parapet. For filling the enclosed area 27 million cubic yards of material are required, and the bulk of it will be dredged from the sea bed of the harbour on the east side of the Colaba peninsula and pumped over the intervening narrow neck of land on to the enclosure. A suction cutter dredger to be used for this work has just been completed by Messrs. Simons and Co., of Renfrew. The vessel is stated to be the largest of its type yet built, dredges to 70ft. depth and discharges 2000 cubic yards per hour through 5000ft. of pipe. As a considerable part of the reclamation is beyond the reach of this pipe line, re-pumping stations will be erected on the enclosed area for distributing the material.

Rangoon.—An interesting situation has developed at Rangoon in connection with the consideration of alternative and rival schemes for the extension of the port facilities necessary to meet its rapidly increasing trade. Up to the present all cargo berths are on the river side above the confluence of the Pegu River with the Rangoon River, and cargo is dealt with at wharves, jetties, and pontoons. There are no closed docks or basins and the rise of tide at springs is about 18ft. 9in. In 1920 the Port Commissioners' consulting engineers, Mr. C. S. Meik and Sir George Buchanan, proposed a scheme of additional training walls and dredging for the improvement of the navigation, estimated to cost 2 crores. The new chairman of the Commission, Mr. Cherry, appointed in December, 1920, has put before the Commission an ambitious scheme for the construction of a large dock at Dawbon at the junction of the two rivers, which is a complete departure from the previously accepted lines of port development at Rangoon. We published a description of the project in our issue of November 25th last. In conjunction with this scheme Mr. Niven, the recently appointed chief engineer of the port, has put forward proposals for a modified scheme of river training in the vicinity of the Hastings Shoal, which is estimated to cost 30 lakhs of rupees, compared with 2 crores (1 crore = 100 lakhs) for the earlier proposals. The Port Commissioners are stated to have approved the Dawbon project and to have authorised the necessary preliminary surveys and borings, which are already in progress. Sir George Buchanan, who was for twenty years chairman and chief engineer of the port of Rangoon, and his partner, Mr. Meik, are emphatically opposed to the Dawbon scheme, which they consider, "if proceeded with, would ultimately result in the bankruptcy of a flourishing port."

Other Ports in India and Ceylon.

The Bengal-Nagpur Railway Company has undertaken the development of the harbour at Vizagapatam, and improvement works have recently been started. At the request of the Madras Government, Messrs. Sir John Wolfe-Barry and Partners have investigated a number of possible harbour sites on the coast of Southern India, and have recently made their report. They propose Tuticorin as being the only port, other than Vizagapatam, which the Bengal-Nagpur Railway Company is developing, in which harbour works on a considerable scale could be constructed with advantage. Their recommendations include the construction of quays and the provision of an entrance channel 30ft. in depth.

At Colombo the harbour is in course of being deepened for the accommodation of vessels of 33ft. draught.

FOREIGN PORTS.

New York.

During the year much attention was given to the future of the port of New York, which, it is admitted, is congested both as regards the quay accommodation and the railway facilities for sea-borne exports and imports. The New York Commissioner of Docks, Mr. Hulbert, after a tour of inspection of European ports, submitted a report to the New York and New Jersey Inter-state Commission, in which he propounds a huge scheme for the complete reconstruction of rail and water facilities at an estimated cost of 225 million dollars. This project, which deals with the entire freight problem of the port of New York in a drastic manner, is now being considered by the new Inter-state Port Authority which has been created by recent legislation of the States of New York and New Jersey and confirmed by a Federal Act.

The Lehigh Valley Railway Co. is constructing a great marine terminal of the line at Jersey City. The works comprise three piers varying in width from 400ft. to 700ft. with berthing slips between, the longest of which is 7800ft. The total length of the berthing accommodation will be between 5 and 6 miles. The piers will be provided with an elaborate equipment of cargo and ore-handling appliances.

The completion of the New York State Barge Canal has not been followed by the development of trade on and in connection with it that was anticipated. Nevertheless, large sums are now being spent on the construction of barge terminals for the canal service at the New York end which, it is hoped, will encourage the development of the canal traffic.

On both sides of New York Harbour the construction of new deep-water piers is being carried on to an unprecedented extent; the slips or berths alongside these piers are many of them over 1000ft. in length. On the north side of Staten Island, in New York Harbour, twelve new piers ranging from 1000ft. to 1330ft. in length and from 125ft. to 209ft. in width are now being constructed. Other similar piers are being built at Brooklyn, on the New Jersey side.

San Francisco.

The congestion of the water front of the city of San Francisco has forced attention to other parts of the great natural harbour as sites for the development of sea-borne import and export trade. A big project to construct deep-water piers on the water front of Berkley, on the opposite side of the harbour to San Francisco, has recently been laid before the Federal and local authorities. That some other site than the congested water front of San Francisco city must be found for future port developments on a large scale is admitted on all sides, and the ambitious Berkley project seems to have been welcomed as a satisfactory solution.

New Orleans.

The construction of a ship canal from the river Mississippi near New Orleans to Lake Pontchartrain, a distance of between 5 and 6 miles, was commenced in 1918, and is reported to be now nearing completion. The canal has a depth of 30ft., the width at the bottom is 150ft., and at the water level 300ft. The entrance lock at the Mississippi end is 640ft. long by 75ft. wide internally, and has a depth over the sill of 35ft. The cost of this new waterway is estimated to be 20,000,000 dols.

The New Orleans Harbour Board, which has borne a part of the cost of the canal undertaking, is also engaged in providing improved coal-shipping appliances costing 750,000 dols., and in making increased provision for shipping grain and cotton.

Other American Ports.

At Buffalo the deepening of the harbour and its approaches is now in progress. At Seattle much work is in hand on the water front, including the provision of oil storage facilities. At Baltimore the construction of a new grain elevator is proposed and many new piers are being constructed. Norfolk is about to commence a big project of port improvements, which includes the construction of large grain elevators. At Wilmington (Delaware) a contract for harbour improvement works to cost 1,750,000 dols. was let towards the end of the year by the Federal Government. At Philadelphia an extensive project of new deep-water pier construction is now being carried out by the municipality. At the same time large sums are being spent in the improvement of the mechanical equipment of the port. At Chicago and Detroit (Mich.) important works are in hand, and at Portland (Oregon) terminal facilities for grain and oil, including grain storage and elevators, deep-water piers and transit sheds are under construction by the Municipal Docks Commission. Among other American ports where large works are in progress are Savannah, Houston and Galveston.

Belgium.

The Ministry of Public Works of Belgium is busily engaged in improving the numerous waterways and canals in that country. The damage done to the canals and other works during the war has now been made good, but there remains an immense programme of improvements, many of which were sanctioned before the war, only a small fraction of which has yet been completed. In addition to the works at Antwerp, which we refer to in more detail below, the Government proposes to carry out in the near future important harbour and docks improvements at Ostend and Zeebrugge and in connection with the Ghent-Terneuzen Canal. At Ghent the docks are being extended by the construction of an arm 1640ft. by 656ft.

The new works for the improvement of the port of Antwerp, which were authorised in 1912, are now under construction. This scheme, the execution of which had hardly been commenced at the outbreak of war in 1914, had been prepared in substitution for the much-discussed "Grande Coupure" project, to which considerable opposition had been offered and which was ultimately abandoned. The project now in hand includes the construction of two tidal locks at Kruisschaus, on the right bank of the Scheldt, about 7 miles below the principal existing entrance to the Antwerp docks at Kattendyk, together with a dockised cut extending from the new locks to the docks at the north end of the Antwerp system, which were completed in 1914. The communication passage or dock will be a little over 3 miles long and have a width varying from 820ft. to 1300ft.; the depth in the dock will be 12 m., which may be increased when necessary to 14 m. The construction of the smaller of the two tidal locks at Kruisschaus is now in hand. It is 270 m. long by 35 m. wide internally, and will have a depth over the sill of about 14 m. at high water. The larger of the two locks has not yet been commenced, but work has recently been started on the communication dock. It is expected that these works will be completed in about five years. It is proposed ultimately to construct a series of branch docks in connection with the communication dock, which, with the new tidal locks, will provide access to an area of land capable of development on a large scale.

The Antwerp Harbour authorities have during the past year carried out large extensions to the cold storage equipment of the port.

Canal du Centre, Belgium.

The completion of the works which have been carried on spasmodically for over thirty years in connection with the Canal du Centre provides a waterway for through traffic between the basins of the Meuse and the Scheldt in southern Belgium. The

last item of these works, the construction of three out of four lift locks, was in hand before the war, and since the Armistice work has been resumed, with the result that the locks were completed recently and the navigation opened for traffic throughout its full length. The lifts consist of two steel tanks placed side by side, each measuring 141ft. by 19ft., carried upon and lifted by hydraulic rams. The lift of the original La Louvière lock, constructed as long ago as 1888, is 50ft. 6in., while the three additional locks recently completed have lifts of 53ft. 7in. in every case. We published in our issue of August 26th an illustrated description of these interesting works.

Holland.

The new lock at the entrance to the North Sea-Amsterdam Ship Canal at Ymuiden is now under construction. It will be, when completed, 1110ft. in length, 165ft. wide, with a depth of water of 49½ft. over the sill. The lock heads, lock walls and gate recesses are being constructed as reinforced concrete caissons. In connection with the new entrance, a new North Pier, 1¼ miles long, and an extension of the South Pier, 3830ft. in length, are being built.

In connection with the Zuider Zee reclamation scheme, work upon which was commenced in 1920, the construction of a dyke or embankment between the mainland of North Holland and the island of Wieringen is in progress. It forms the first section of the great enclosing embankment which is to be constructed between North Holland and Friesland, inside of which will ultimately be formed the Yssel Lake, and some half-million acres of reclaimed land. The original estimate of the cost of the whole scheme, made in 1914, was about 230,000,000 florins (£19,000,000), but according to a recent article in *The Times* by Dr. Lely, the former Minister of the Waterstaat, the cost under present conditions will probably be doubled.

Havre.

The port extension works authorised in the years 1909, 1911 and 1912, which were estimated to cost before the war £3,400,000, were still incomplete when hostilities broke out. After the war the completion of the original programme was taken in hand and a further scheme of port development was authorised in 1919, the execution of which has now been commenced. Under this scheme the depth of water in the entrances, the *avant port*, communication passages and tidal basins is being increased to 10.5 m. at L.W.O.S.T., or about 19 m. at H.W.O.S.T. Berths for ships drawing 40ft. are to be available at all states of the tide, and some 12,000ft. of new quays will be added to the accommodation of the port. The deep-water quay, with a depth of 41ft. alongside, which was authorised in 1909, is now nearing completion. The wall was built on steel caissons sunk by compressed air.

The large dry dock, also authorised in 1909, is still under construction; when completed it will have an available length of 312 m., with a width at entrance of 38 m. The depth over sill at L.W.O.S.T. will be 28ft. 6in. The dock is constructed on a steel pontoon or caisson, measuring 1132ft. by 197ft., which was constructed complete and floated out over the site of the dock, which had previously been dredged to the required level. After sinking the pontoon was filled with concrete and the dock superstructure erected upon it. The new breakwater works, authorised in 1909, have been completed, but a further extension of the South Breakwater was authorised in 1919, as well as the construction of additional dry docks.

The widening and deepening of the Tancarville Canal and the provision of additional warehouse accommodation at Havre have recently been sanctioned by the French Government.

Marseilles.

The construction of the Rhone Canal between Marseilles and Port-de-Bouc has been resumed since the war, and work on the great Rove Ship Tunnel, which is the most striking feature of the undertaking, is being pressed forward rapidly. In connection with the canal, reclamation work is being done at both ends, and the construction of basins and other terminal facilities has been begun.

In the port of Marseilles itself a big programme of improvements is in hand. The Bassin President Wilson, which was constructed during the war, is being equipped with up-to-date appliances, and this work is now nearing completion. Several of the older basins are being deepened, and this work entails the reconstruction of many of the old quay walls. The construction of a sixth basin, to the northward of the Bassin President Wilson, with a new northern outer harbour, and containing over two miles of quays, is about to be commenced. This basin is to be called the Bassin Mirabeau, and the depth of water alongside its quays will be about 42ft. The programme approved by the French Government early in the year provides for other works in the port, including the construction of a large floating dock.

Rouen.

In September, 1920, the first stone of the new Saint-Gervais Dock at Rouen was laid, and the work of construction is now in full swing. This work formed a part of a programme of port development at Rouen which was approved in 1913, but was not proceeded with owing to the war. The dock—or rather basin, for there will be no gates and the water area is open to the river—will have a depth of 29ft. 6in. over a water area of 88 acres. The passage giving access to the basin from the Seine is to be 150 yards in width, and there will be 3640 yards of quay frontage. The site of the dock is on the north bank of the Seine below the city. Other works of importance are included in the improvement scheme, some of which are now being proceeded with, among them the provision of additional river wharves with a minimum depth of 30ft. alongside, the regulation of the channel of the river Seine, and its deepening to 26ft. at minimum low water. The deepening of the river in the vicinity of the port is to be carried to a depth of 28ft. at low water.

Other French Ports.

Among other French ports at which improvement work on a large scale is in progress or has recently been sanctioned by the Government are Dunkirk, Dieppe, Nantes and St. Nazaire, Caen, and St. Malo. The improvement of the river Seine between Rouen and Paris and canal navigation serving the capital is receiving a good deal of attention at present, work being in hand on portions of the scheme for the development of Paris as a port for the overseas and coasting trades, while further great expenditure is in contemplation.

French Colonial Ports.

Port construction and improvements on a large scale are under consideration in connection with a number of harbours in French Colonies, dependencies and spheres of influence. Dakar Harbour, in West Africa, is to be extended, and a project, estimated to cost 162 million francs, for the improvement and enlargement of the harbour at Algiers was approved by the French Government during the year. An extension of Oran Harbour in Algeria is also proposed.

At Casablanca, in Morocco, the port authority is engaged on a harbour project sanctioned in 1920, which is estimated to cost 220 million francs. Some of the new jetties and quays have been completed during the year and are already in use.

Harbour works are proposed at four ports in Indo-China, viz., Saigon-Cholon, Haiphong, Toruane and Quang-cheu-Wan, and at Tamatave in Madagascar. At Jibutil in Somaliland it is intended to construct a port of call.

Copenhagen.

The port of Copenhagen comprises for purposes of administration two distinct portions, one of which is owned and worked by the general port authority and is the Customs port, while the other is the "Customs free" port, equipped and worked by the Free Port Company, although the major part of the works in it have been and are being constructed for the company by the port administration. Following on such an agreement, made in 1915, the free port works have been very largely augmented and improved in course of the past few years, and the original project has now been practically completed. The new basin—Kronelöbs Basin—has its walls formed of reinforced concrete caissons, measuring 49 m. long by 7 m. wide, sunk on a prepared foundation 30ft. below water level. The depth in the basin is 31ft. Similar caissons have been used for the construction of the breakwater or pier flanking the channel leading to the basin. A further extension of the free port in the form of a basin to the north of the Kronelöbs is now in progress. It will have a depth of 33ft. The main channel, or Kronelöbet, is being deepened from 29ft. 6in. to 32ft. 9in., and the Teglholmew Harbour works at the end of the harbour area remote from the Kronelöbs, which were begun in 1916, are nearing completion. The harbour of Copenhagen is practically tideless.

Shanghai.

The Whang-Poo Conservancy Board, which is the port authority of Shanghai and its river, the Whang-Poo, or Huang Pu, is faced with the difficult problem of the future development of the port. The channel of the river is at present maintained with difficulty at a depth of from 24ft. to 26ft. at low water between Shanghai and the Woosung Bar at the junction of the Huang Pu and Yangtse. The outer bar of the Yangtse River—called the Fairy Flats—has only 16ft. available at lowest low water and 28ft. to 30ft. at high water springs. The problem is whether the development of the port should be attempted by the further improvement of the present river harbour between Woosung and Shanghai, a length of about 21 miles, and the dredging and maintenance of a deeper channel over the outer bar, or, if this is considered impracticable or unsatisfactory, whether a new deep-water harbour should be constructed below Woosung in Hang-Chou Bay or elsewhere. With the object of settling this difficult problem, the Conservancy Board in November assembled at Shanghai an International Commission of Engineers, who will investigate and report on the various alternative projects which have been put before them. The British member of the Commission is Mr. F. Palmer, C.I.E., America is represented by General S. W. Goethals, and, in addition, there are nominees of France, Holland and Japan.

Other Ports.

In the Eastern Mediterranean many schemes for the improvement of existing and the construction of new harbours and docks are being talked about, and some projects have even been advanced so far as the stage of completed surveys and plans, but the disturbed political and financial situation has hitherto prevented any material progress being made with works on a large scale. Among these works are schemes for port development in Greece and other of the Balkan States, and in Asia Minor. The Italian Government has decided to carry out important improvements at Naples and Genoa.

Japan is busy with the development of commercial ports, among the works in hand being the reconstruction of Shimidza Harbour, an important centre of the tea export trade.

In Cuba the harbour of Santiago has been greatly improved. A reinforced concrete wharf for ships drawing 26ft. and extensive warehouse accommodation are among the works now in hand. At Helsingfors, in Finland, the construction of new quays with 30ft. depth of water alongside is in hand. The free port of Stockholm is to be extended by the construction of new piers and quays. At Valparaiso the harbour works, which have been under construction for nearly ten years, are not yet completed. The breakwater, which terminates in the extraordinary depth of 60 m., is still under construction, and it is now proposed to extend it by the construction of a protecting arm, starting at the outer end of the work, as originally planned, and at an angle with it, and following generally the 60 m. contour. The floating dock at Valparaiso was lost in the course of the summer, and is to be replaced by a new dock at an estimated cost of £200,000.

The European Commission of the Danube in January, 1921, appointed an International Committee of Engineers to report on the improvement of the navigation at and near its mouth. The investigations have been carried out, and the report of the Committee was expected to be ready for presentation at the end of the year 1921.

The improvement of the harbour of Punta Arenas, it is stated, is to be undertaken shortly by the Chilian Government. Port development works are also to be carried out by the Peruvian Government at Callao. Harbour works extensions are also in hand at Pernambuco.

New piers are being built at Arica and Puerto Huasco in Chili, and an expenditure of £600,000 on the improvement of the port of Rosario is proposed. The Argentine Government has recently entered into a contract for the completion of the new harbour works at Buenos Aires. The Mexican Government is improving the harbour at Guaymas, in the State of Sonora, and has granted a concession to a private company for the construction and equipment of wharves and warehouses at Vera Cruz. Harbour works are in course of construction at Haifa in Palestine, and a project for the building of a breakwater and wharves at Jaffa is under consideration.

Friction Lifters for Drop Stamps.

No. I.

By W. H. SNOW, Wh. Ex.

THE oldest and simplest friction lifter is the "kick" stamp device, consisting of a belt, generally of steel, passing over a continually revolving pulley—Fig. 1—the belt being attached at one end to the stamp head or tup and pulled at the other by manual effort, the friction between the belt and pulley for the most part raising the tup. The pulling rope attached to the belt is lengthened and provided with a stirrup, so that the operator, in addition to pulling with his two hands, can get a foot on the rope and increase his effort, the back kick developed in the act of working giving the name to this type of stamp.

The pulley diameters met with are 30in. to 36in.—generally the latter. The diameter should bear some relation to the thickness of belt to allow for easy bending; but as it is usual to have several stamps working on one shaft, the diameter is fixed by considerations of lifting speed, which is as a rule 500ft. to 600ft. per minute, taken as the rim velocity of the pulley, a 3ft. pulley running at 50 or 60 revolutions per minute. To reduce the pulling effort to a minimum the friction is kept artificially high by the use of chalk or plaster of Paris. Experiments show that μ may be as high as 1.0, so that, using the expression

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

we get (with $\theta = 170$ deg.) a ratio of tensions of the order of 20 to 1. This figure agrees with experience, a lad—exerting a pull of 40 lb. to 50 lb.—being able to work a 6 cwt. stamp, and a strong youth one of 10 cwt. to 12 cwt. whilst three men are required for a 40 cwt. stamp.

The ratio between weight lifted and pulling effort is a simple one when the speed is steady, *i.e.*, after

slipping has ceased and the belt is moving with the velocity of the drum. Before this state is reached extra effort must be exerted to start movement and produce acceleration. The puller takes advantage of any rebound after a live blow, but after a dead blow the hammer must be started from rest. The greater the pull the more rapidly is speed acquired and the faster the blows are delivered. Fig. 2 shows the relation between blows per minute, accelerating force, and maximum lifting speed V. The accelerating force

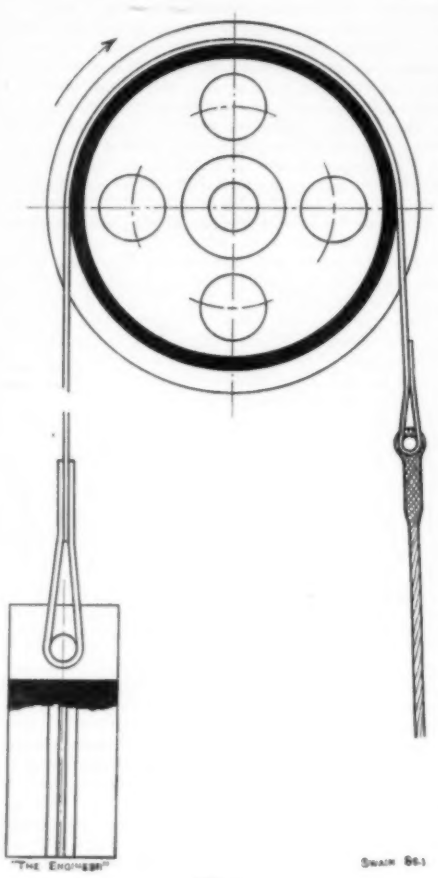


FIG. 1

$= F - W$, W being the minimum force necessary for steady lifting, and the diagram is based on the expression for time of lift and fall $t_1 + t_2 = \frac{S}{V} + \frac{V}{2g} \times \frac{F}{F-W} + \sqrt{\frac{2S}{g}}$. S is the stroke or fall. It will be seen that more blows per minute are obtained with a drum speed of 400ft. per minute, and the accelerating force $\frac{W}{2}$, *i.e.*, maximum force $1\frac{1}{2}$ W, than with 600ft. and $\frac{W}{4}$. The diagram throws light on the divergence in practice found between kick stamps and stamps equipped with lifters of recent design, which are to be described later.

In these recent designs the effort for operating has been reduced to a hand pull of a few pounds, and a force twice as great as that necessary for steady lifting is easily produced. When, however, as in the kick stamp, the least pull needed is already considerable, it is clear that the extra force for accelerating can only be of a low fractional order perhaps $\frac{1}{3}$ to $\frac{1}{4}$, necessitating the use of a high velocity to get the most out of the stamp. Acceleration in this case continues for the greater part of the stroke, as will be seen from Fig. 3, and this may be said to be in accordance with expectations where the relationship between cause and effect is so direct as in the kick stamp. The puller exerting all his effort will expect to see a continued increase in the speed of the tup, and the condition for satisfaction is that the drum speed shall be high enough to be only just reached at the point where pulling must cease to let the tup come to rest within the limit of stroke. This gives the highest average velocity for a given acceleration, and thus the maximum number of blows per minute. The extra "fling" with a high lifting speed is also a point that the puller will not fail to discover in his favour. (It is of interest to note that for low acceleration 600ft. per minute is a critical speed, anything higher or lower resulting in a falling off of blow production, assuming the full speed to be reached.) The result is only got by wasting power, unavoidably lost owing to slipping during acceleration, the loss being greater the longer the period of acceleration, as shown by Fig. 3. This is primarily a velocity diagram on a time base which divides into the three periods—acceleration, steady lifting, and retardation. The area *a b c d* can be made to represent work done by introducing the constant W (or $T_1 - T_2$ if we consider only the work done by the engine or motor) into the expression for area *v t* (W) $= s$ (W), *v* being the average velocity. This area represents the useful work done. The work wasted in slipping is given by the area bounded by the slip velocity line *a f*, using here the constant F instead of W. The forces are the actual pulls on the tup. Slip = V at *a* and 0 at *h*. F is assumed constant, but actually it may vary. The sum of the tup and slip velocities is, of course, V, given by the line *e f* to the proper scale, and the total work done during acceleration = *a e f h*, of which *a b h* is done in raising the tup, *a f b* in giving it velocity, and *a e f* is wasted in friction; *a f b* reappears at the end of the stroke, the tup completing its movement by virtue of its kinetic energy (producing "fling"). Pulling ceases at *m* and *m c d* = *a f b*. V and F are assumed constant for simplicity. With V variable, as when fly-wheel effect is introduced, *e f* and *b c* become sloped and there is more work lost.

To show the loss of efficiency when V is high and F small, the dotted line diagram has been drawn, F_1 being chosen to make t_1 the same as for the full-line diagram. The efficiency where $F = 1.5$ W is 78 per cent., whereas where $F_1 = 1.31$ W it is only 51 per cent., showing the desirability of working with high acceleration. The expression for efficiency is $S \div S + \frac{V^2}{2g} \times \frac{F}{F-W}$. The maximum theoretical efficiency for 7ft. stroke and V = 400ft. per minute is 91 per cent.

MODIFIED KICK STAMPS.

Various modifications of the kick stamp lifting device are in use which, while not involving a departure from the simplicity that is a desirable thing in a stamping plant, enable stamps to be worked with less effort and fatigue. One which is extremely simple in form, though involving some complication in its theory of action, is shown in Fig. 4. It consists of an outer band A B of steel fixed at one end A lying on a kick stamp belt C—also of steel—and pressed on to the latter by being pulled at B, the force being obtained through a hand lever arranged conveniently near the ground. The action depends on the friction between the two bands being less than that between the inner one and drum. The former is reduced by oiling and the latter kept up as by a chalk or plaster dressing already described.

Applying the usual theory for coil friction, it can be shown that the ratio of weight lifted to effort needed at the free end of the outer band $= \frac{W}{p} = e^{\mu\theta} - e^{\mu_1\theta}$ for steady conditions, μ being the coefficient of friction between the inner band and drum and μ_1 that between the two bands, θ being the common angle of contact. In Fig. 5 curves have been drawn for values of μ_1 from 0 to 0.3, giving $\frac{W}{p}$ for varying values of μ, and a curve for the simple band is shown for comparison. The pull for the double arrangement is always greater than for the simple band, but is obtained without difficulty by using a lever proportioned to need only a small hand effort, the movement being small.

Power is necessarily wasted owing to the rubbing taking place between the two bands, and this is the price paid for the advantage of easy operation and simplicity. The outer band acts, of course, as a brake and the power lost depends on two things: the friction between the bands and the pull applied.

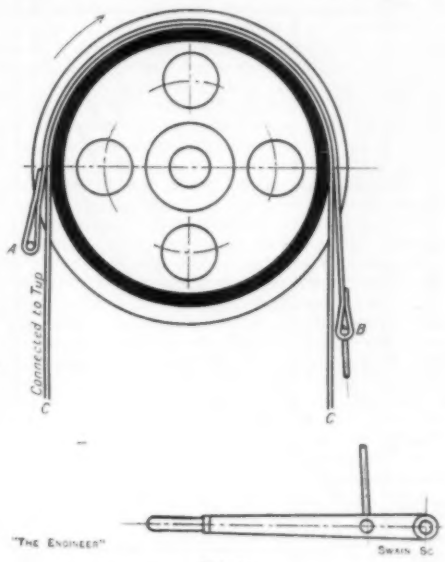


FIG. 4

If matters are made very easy for the operator it is quite likely that he will pull in excess of the minimum required by the conditions given by the curves, and the surplus pull means wasted power.

The extent of the loss due to the braking action can be shown in Fig. 3 by adding lines below the base line to represent the velocity of rubbing, and in this case the whole of the work throughout the stroke is frictional. The braking effect is given by $T_3 - T_4$ (the difference in tensions in the two ends of the outer band) multiplied by velocity of rubbing. $T_3 - T_4 = T \frac{e^{\mu_1\theta} - 1}{e^{\mu\theta} - e^{\mu_1\theta}}$, and calling the fraction *n*, the efficiency is $S \div S\left(1 + \frac{F\,n}{W}\right) + \frac{V^2}{2g} \times \frac{F}{F-W}$. For

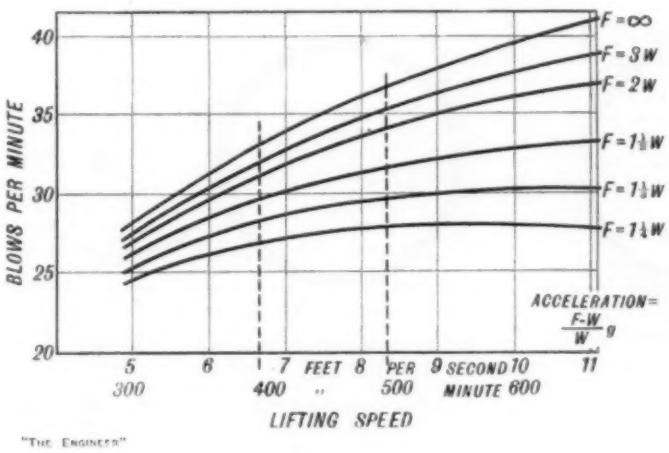


FIG. 2

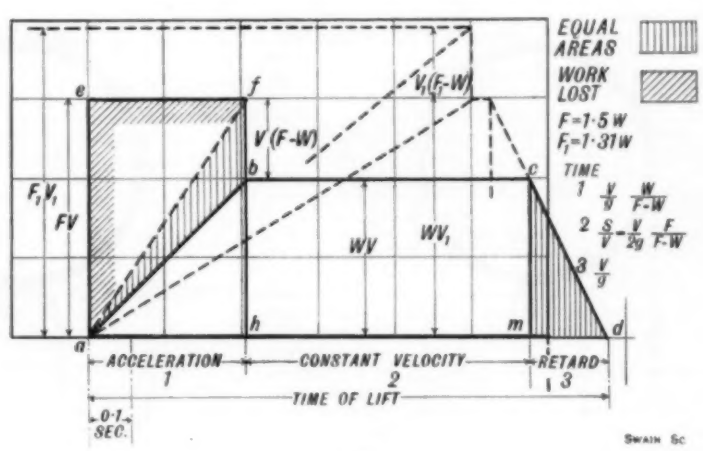


FIG. 3

a value of $n = \frac{1}{3}$ resulting when $\mu = .7$ and $\mu_1 = .15$ (approx.), the efficiency with V = 400 and F = 1.5 W is 69 per cent. In many cases V = 600 (where the lifter has been applied to an existing kick stamp without change of speed) and here the efficiency will be only 55 per cent.

It will be seen that with fairly high values of μ, say .8 and up, and μ_1 below .15, the device is reasonably efficient at moderate lifting speeds. The frictional requirements, however, are mutually at variance. Neglect to ensure that μ shall not fall and μ_1 rise is always probable, and such neglect is likely to continue until the engine or motor gives warning. Further, the frictional loss appears as heat, the bands get hot, and this aggravates the conditions at the friction surfaces.

This type of lifter is much less easy to control than the kick stamp, and care and skill are needed to vary the stroke and blow and to keep the tup suspended steadily. The tension in the outer band varies along the arc of contact just as in the kick stamp band. The greatest tension, when lifting, is at the fixed end; when lowering, at the free end. The reaction on the inner band is thus, when lifting, least where the effect is most productive, viz., at the side where the free end of the lifting band leaves, tension set up on this side resulting in a higher tension at the other side owing to the coiling. Thus a greater pull is necessary for lifting than for (slow) lowering, whereas in the kick stamp there is an equilibrium value short of which the tup will fall, and above

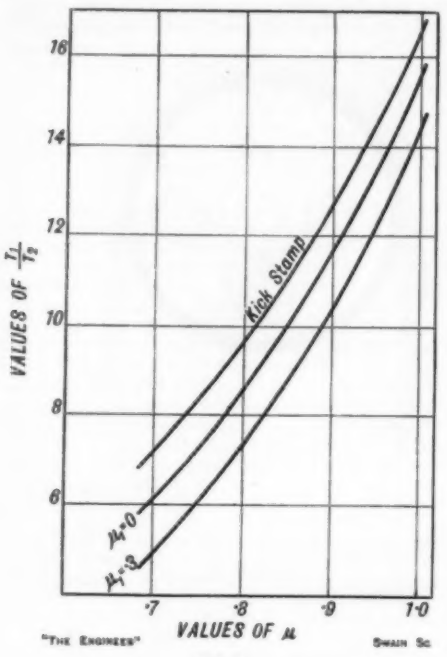


FIG. 5

which it will rise. The non-effective range is given by $1 - \frac{\mu - \mu_1}{\mu + \mu_1}$, the fraction giving the ratio between the pulls for lowering and lifting respectively. For the best control there must be a ready response to any change in pull or movement given by the operator. The difficulty of judging of the effect which will follow a change of effort is increased by the uncertainty of the values of μ and μ_1. Further reasons for the lack of control will presently be shown.

Other modifications of the kick stamp are shown in Figs. 6, 7, and 8. In these forms the lifting belt is pressed on to the drum by a roller at one point instead of, as in the arrangement previously described, being pressed on along the whole arc of contact. If P is the force, then a tension P μ is set up in the band, and $\frac{W}{P\mu} = e^{\mu\theta}$, giving $P = \frac{W}{\mu e^{\mu\theta}}$. Fig. 7 shows a form which has been made on the Continent in large sizes with woven belts up to 30in. width and 1in. thickness. The greater angle of lap as compared with Fig. 6 reduces the operating force and the local pressure on the belt, but results in the band dragging and thereby retarding the fall and reducing the blow. This is a point to be watched in all these forms of lifter, especially where μ is high or the belt heavy. Special devices for keeping the belt out of contact with the pulley when the tension is released are sometimes employed.

The control is better than in the case of the double-band lifter, as there is no hiatus between the lifting and lowering forces, though except in Fig. 8 it is not so good as in the kick stamp. In Fig. 8 the spiral form is given to the pulley to obtain a "hunting" movement, making it necessary, in order to maintain contact, to follow up continually with the hand, the movement resulting from the movement of the tup. The operator being sensible of this movement is enabled to control the stroke and force of the blow in a way not possible where these depend on skilful judging of the duration of the pull, as in Figs. 4, 6, and 7. The action is an imitation on a small scale of the operation of the kick stamp. Where the stroke is short a good hunting device sometimes employed is got by connecting the lever and tup by a cord and pulling at an intermediate point through a pulley round which the cord is passed. Fig. 8 shows a type not much used. Fig. 6 is employed a good deal on intermittent work of a straightforward character, mostly in small sizes.

For successful operation under severe conditions and uniformity of performance in all sizes the basis of design must be the limiting pressure that the material of the friction band will stand without wearing too rapidly or overheating. A faulty feature in the forms of lifter just described is the localisation of the pressure. Taking $\mu = .33$, $\theta = 180$, then P = W approximately, and tension in the band just above the roller = $\frac{1}{2}$ W, P and W being taken per 1in. width of band. The pressure per square inch $= \frac{\text{tension}}{\text{radius of drum}}$. If radius of drum = 12in., then pressure at 180 deg. from roller $= \frac{W}{12}$; immediately above the roller it is $\frac{\frac{1}{2}W}{12} = \frac{W}{36}$, but on the line of contact it is W ÷ contact area per 1in. width. The denominator will depend on the diameter of roller, but taking it very liberally at 1 square inch, the extreme localisation of the pressure is sufficiently evident. A 15 cwt. stamp will be found with a belt perhaps 6in. wide, which gives, allowing for weight of die, a tension of 300 lb. per inch width, and this figure gives the pressure per square inch under the roller. With $\mu = .46$ the figure is halved. For material specially treated for friction purposes 50 lb. to 100 lb. per square inch is a good rule, so it will be seen that excessive wear will occur with ordinary woven belting if much slipping takes place. The design of such lifters may proceed in two ways. The capacities of "similar" lifters would vary as the squares of the linear dimensions. A 12in. belt would have double the thickness of a 6in. (15 cwt. size) and would carry four times the weight (60 cwt.). The drum and roller for this latter would have double the diameter of the 15 cwt. size in order that the breadth of the contact line should vary proportionately to give four times the area as required if the pressure per square inch is not to be increased, and to allow of easy bending. The rim speed must remain practically constant and the revolutions per minute must therefore be halved. But, as already pointed out, this would be inconvenient, as well as costly in gearing, and in practice the diameter is kept constant and designing is simply a matter of alteration to width. Hence the very wide belts in large sizes, though the difficulty is partly one of the weaving of thick belts.

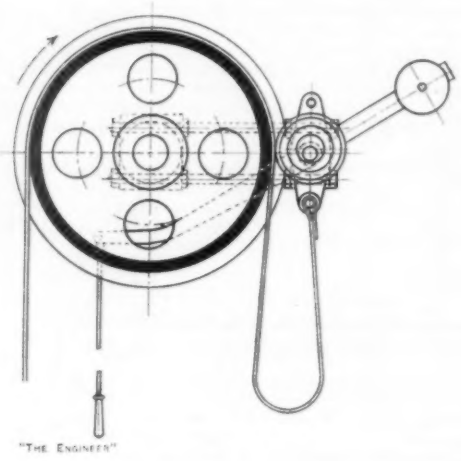


FIG. 6

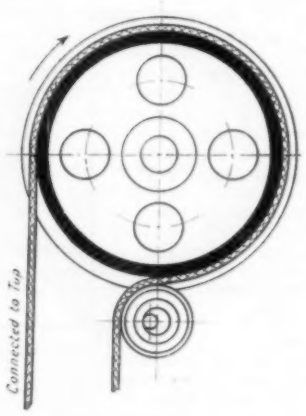


FIG. 7

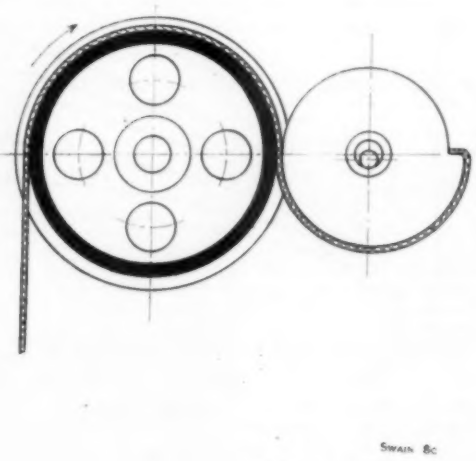


FIG. 8

IT is reported that a company for the construction of the Rhine-Maine-Danube Canal was founded on December 30th at Munich, with a capital of 200 000 000 marks. It is estimated that the waterway will take twenty years to complete. It will be made available for ships of 1500 tons and will provide a connecting link between the North and Black Seas. The Central and Bavarian Governments, industrial, banking, and shipping circles are, it is said, represented on the board of directors.

Gas Engineering in 1921.

So far as the gas industry was concerned the past year was by no means without incident. It is doubtful whether the present generation of gas engineers will ever forget the chaotic conditions which ruled during the three months of the miners' dispute, while they had in addition to feel their way with the entirely new state of affairs introduced by the general operation of the Gas Regulation Act of 1920. It will be recalled that the new Act—which has rightly been described as epoch-making—placed all but the smallest undertakings under an obligation to sell gas on a basis of heat in lieu of the old method of charging by volume. In exchange for this concession to the consumer the manufacturers were permitted a free choice in the matter of the quality (*i.e.*, thermal concentration) of the gas supplied, this property not affecting the consumer who now pays for the useful heat, or therms, only. During the year the majority of the more important undertakings changed over to the therm basis; and, although a good deal of preliminary work was necessarily involved, it was encouraging to find that no difficulties arose in making so radical an alteration. Prior to the introduction of the "selling by heat" basis it was generally predicted that, as British thermal units can probably be produced more cheaply in low rather than high concentration, some material reduction of the then quality of the gas was to be looked for when the therm system came into operation. Contrary to expectations, however, little modification actually occurred, which—as it meant that consumers' appliances had not to be adjusted to meet new conditions—no doubt accounted for the smooth manner in which the change to the new method of selling was effected throughout the country. It may, in fact, be said with confidence that, the innovations resulting from the Gas Regulation Act having been on probation for a year, general experience of both manufacturer and consumer pointed to the successful solution of a problem which had for long handicapped the interests of both parties.

The Composition of Gas.

Although the main provisions of the new Act were put into operation during the year there still remained to be settled some of the minor, but nevertheless important features. Chief among these were the questions in connection with incombustibles and carbon monoxide in towns' gas which had been referred to two committees consisting of members well known in the field of fuel technology. Needless to say, the uncertainty which prevailed in connection with the possible restriction of certain gaseous constituents gave rise to a good deal of anxiety on the part of gas engineers. It was rightly felt that the modifications introduced by the Act were in themselves sufficiently sweeping without being encumbered with additional strictures, the practical value of which was open to considerable doubt. There can be no question that during the war the proportion of incombustibles in towns' gas exceeded on some occasions the limit of propriety. Considering the difficulties which were laboured under the fact was excusable; but, as gas was then sold on the basis of cubic feet, the consumer had some cause for complaint. To-day, however, diluents are of no commercial value to the purveyor, and the case against them is entirely changed when it is borne in mind that if the consumer gets them he gets them free of charge. In this connection, too, it is important to remember the generally accepted opinion that a British thermal unit is always capable of giving a definite duty whether it be supplied in a concentrated mixture or one of leaner propensities. Fortunately, the Incombustibles Committee appreciated the true position; it decided to make no recommendation in the way of restriction, but suggested that the position should be reconsidered in three years' time.

So far as the limitation of carbon monoxide is

concerned, there can be no question that it adds to the toxicity of towns' gas, but it is not solely responsible for it. There would seem, therefore, to be little object in restricting one not altogether desirable constituent if such restriction only diminishes, and does not eliminate the danger complained of. All the evidence before the Committee went to show that the proportion of truly accidental deaths from gas poisoning was negligible, the majority of fatal cases being represented by wilful self-destruction, in which case—from the humane point of view—the presence of carbon monoxide may be regarded as an advantage rather than a drawback. The Committee evidently appreciated that the matter was largely one of sentiment, for it concluded that it was neither necessary nor desirable to prescribe any limitations. The matter was one of more than ordinary importance to the gas industry, for the limitation of carbon monoxide —and inerts, too, for that matter—would undoubtedly preclude the development of those processes which show considerable promise in the way of producing cheap therms.

The Coal Stoppage.

The protracted miners' dispute dealt a severe blow to the gas industry mainly on account of the fact that the new legislation had just begun to bring in its train the prospect of greater prosperity for shareholders in the gas undertakings. It so happened, however, that in many cases the additional cost of carrying on during the period of the coal stoppage more than absorbed the sum required to pay the normal dividends. It must be placed to the credit of the industry that, in all but a few isolated instances, the supply of gas was maintained uninterrupted and without any declension in the normal quality of the product. As to the ways and means adopted they were fully explained at the time in an editorial article in THE ENGINEER. Briefly, it may be repeated that the situation—which, when once the stocks of native coal had been worked out, assumed a serious aspect—was saved by the wholesale importation of coal from the north-eastern fields of France, from Belgium, and to some extent from America. Unfortunately the continental coal, though it sufficed to make gas, added very considerably to the worries of the gas engineer. In most cases this coal was of execrable quality; it yielded only about 65 per cent. of the quantity of gas normally obtained from native coal, while frequently it gave no coke whatever. The position, in fact, was such that the cost of producing straight coal gas was nearly quadrupled.

The inability to obtain coal naturally led to a heavy demand for gasworks' coke, and had it not been for the assistance derived from the sale of that product it is difficult to see how, financially, the gas undertakings could have weathered the storm. At the critical period of the stoppage an Order in Council was made to the effect that all gasworks must make use of their water gas plants to the fullest capacity, and only utilise their coal gas plant to an extent sufficient to supply the balance of requirements. In the way of water gas production the situation was assisted by the fact that the price of the enriching oil employed had substantially fallen. Thus by the liberal use of oil it was possible to make a high quality water gas which performed a useful service in maintaining the calorific power of the mixed gas as supplied.

Carbonisation Research.

Considerable progress was made in the study of carbonisation, more especially in connection with steaming the coal charge in continuous vertical retorts. A detailed account of the experiments conducted at the Fuel Research Station at East Greenwich was published in June. The installation of vertical retorts at the station was designed to supply accurate data from which the economic possibilities of steaming could be determined. While there still remained many lacunæ in the experimental work, Sir George Beilby thought it possible to speak with considerable confidence about the gain in products and the cost of this gain so far as fuel and labour are concerned. The gain which is of most importance to the gas industry is that of therms in the form of saleable gas. It has been common knowledge for some years that this gain was assured if gas of a calorific value of 400 to 450 B.Th.U. could be established as a saleable commodity. As a result of the progress made at East Greenwich it was possible to conclude that by moderate steaming at moderate temperatures the yield of good quality gas can be greatly increased, while the cost per therm is correspondingly reduced. Provisionally it was assumed that 20 per cent. of steam represents the maximum limit from the economical standpoint; but necessarily the figure must vary in accordance with the variation in the class of coals employed. Of considerable technical interest were the experiments conducted with the carbonisation of peat. In his James Forrest lecture Sir George Beilby pointed out that when containing about 17 per cent. of moisture peat lends itself admirably to carbonisation, whether in vertical retorts at temperatures of 800 deg. Cent. or in steel horizontal retorts at much lower temperatures. The quality of the gas yielded is poor, but the charcoal resulting from carbonisation is an ideal fuel for gas producers.

Continued interest was displayed in the process known as total gasification—a process which, if once perfected, bids fair to provide the key to the production of cheap therms. There is little doubt, however, that, although in theory the system presents few difficulties, in practice many unforeseen problems arise which have for the time being rather shaken the faith of gas engineers. It would almost seem that the question is scarcely being attacked by inventors on the right lines from a structural standpoint, and if success is to be achieved one feels that it must be looked for in some design which breaks away entirely from existing conventions.

Coke and By-products.

So far as by-products were concerned the year was without feature apart from the situation arising in the coke market during the coal dispute. Coke and coal breeze continued to attract attention as fuels for steam raising, but, perhaps, the most interesting developments were those made in connection with the use of coke as a fuel for motor vehicles. It was stated by Mr. E. W. L. Nicol, the engineer of the London Coke Committee, that three or four of the largest power stations in London, whose boilers as yet are only partially equipped with the "Sandwich" system, are already consuming over 100,000 tons of coke per annum. Some exhaustive tests were made by the Gaslight and Coke Company to determine the best efficiency which could be obtained from a Lancashire boiler fired with large coke and fitted with "turbine" furnaces. An impelled draught was used and the coke contained 10.5 per cent. of ash. The tests showed that 8.14 lb. of water were evaporated per pound of coke as fired, while the evaporative power (from and at 212 deg. Fah.) was 9.0 lb. per lb. of the fuel.

As regards motor transport, one well-known firm of steam wagon manufacturers which designed a special boiler for use with coke stated that, with a load of 6 tons, a mileage of 15 per cwt. of coke could be regarded as an average consumption. With coke at 45s. per ton the running costs would amount to 2d. per vehicle mile. Mr. Thomas Clarkson is an advocate of the utilisation of coke for steam raising on motor lorries rather than its conversion into producer gas. He concluded that with petrol at 2s. 4d. per gallon a vehicle-mile costs 4d. for fuel with a 3-ton lorry, that steam raised by means of coke costs 1d., and that producer gas costs about 0.7d. On the face of it the last-named is the cheapest, but expense is incurred in the maintenance of the producer and engine which is not introduced by the steam-driven motor.

Throughout the year sulphate of ammonia was a disappointing market, prices showing a tendency to fall back to those ruling in pre-war years. It was a matter for congratulation to hear from the British Sulphate of Ammonia Federation that the home consumption of this fertiliser was this year no less than four times the consumption in 1914. All producers of fertilisers must appreciate that before the lapse of many years severe competition must inevitably arise from the increased production of synthetic compounds. Thus far their influence has scarcely made itself felt; but it must be borne in mind that the ultimate yield of the synthetic factory at Billingham-on-Tees is to be equivalent to a quarter of a million tons of sulphate of ammonia per annum, in addition to which there will be the output of the Claude plant in Cumberland. The situation, therefore, which is likely to arise in the future will be best understood by recalling that the production of by-product sulphate of ammonia from all sources in this country is no more than 400,000 tons per annum.

Institution of Mechanical Engineers

CO-OPERATION OF THE ENGINEER AND CHEMIST.

THE Institution of Mechanical Engineers held a joint meeting with the Society of Chemical Industry, at Storey's Gate, on January 6th, to discuss a paper on "The Co-operation of the Engineer and Chemist in the Control of Plants and Processes," by Mr. G. M. Gill. The President, Captain Riall Sankey, took the chair, and, as there was no formal business to transact, he immediately invited Mr. Gill to present his paper.

The paper sets forth the experience which Mr. Gill, as chief engineer to the South Metropolitan Gas Company, has had in controlling the working of that plant with the assistance of constant chemical investigations, but as we give the essence of the paper on page 52 of this issue, it is unnecessary to enlarge upon it here. Mr. Gill projected a number of lantern slides on the screen which showed very clearly the variations in the qualities of the coal sent to his company by the collieries, and explained how it was only by instituting a chemical laboratory in Newcastle, for the analysis of the coal as it was shipped, that it was found possible to keep to a reasonably consistent standard in the gas. The results of the analysis are telegraphed daily to London, and the manager is thus in a position to make preparations for dealing with each individual cargo of coal before it arrives. Some other slides illustrated the difficulties which are experienced in building refractory brick settings on account of the variations in the dimensions of the bricks, while another set showed most graphically the risk of fracture in retorts by reason of their irregular shape.

At the invitation of the President, Dr. S. Miall opened the discussion, but, speaking for the chairman of the Chemical Society, he confined his remarks to an expression of pleasure at being present.

Dr. W. R. Ormandy amused the meeting by asking, Was it likely that the collieries would employ chemists for checking the quality of their product, as suggested by the author, so long as they could sell shale at £3 a ton? The idea of selling coal according to its thermal value was, he said, thirty years old; but when the subject was first suggested steam coal could be purchased in the industrial districts for from 3s. to 7s. per ton. In such circumstances fuel costs were a relatively small item in the expenditure of most businesses, and it was considered that it would not be worth while to go to the trouble of testing coal before purchase. In the case of gasworks, however, the conditions were different, and the quality of the coal was a most important factor, so that it was essential for the gas company to see that it was getting proper value in its coal; which could only be done by chemical investigation. In Lancashire some of the large industries, like the cotton spinners and dyers, had made a gallant attempt to force the collieries into selling their coal according to its thermal value, and had attained some measure of success. Dr. Ormandy said that he was purchasing anthracite for his home at a price 25 to 30 per cent. above what it sold for in Barcelona, and in his backyard there was a great heap of incombustible stuff which he had picked out of the coal. Such a condition of affairs was, he considered, equivalent to the collieries getting money out of the public under false pretences, and the Government might, out of its great army of officials, find men to see that the abuse was remedied. The doctor then went on to discuss the troubles caused by irregularities in bricks, and said that he was convinced that even when the tower of Babel was being built the foreman grumbled on that account. The trouble was caused by the careless and conservative methods of the brickmakers, who made no effort to control their product scientifically. In France, however, bricks were made more carefully and there was far less variation in their dimensions. Dr. Ormandy had once recommended some works to use bricks for their furnaces which cost 25 per cent. more than those used before, urging that it would be economical in the long run. As a matter of fact the engineers at the works estimated that if the new bricks doubled the life of the furnaces it would be worth while paying £40 per thousand instead of £4. It was possible, he said, to make fire-bricks which had lost all their contraction and which did not vary in dimensions by more than $^1/_{16}$in.

Mr. Christopher W. James suggested that as there was no compulsion about buying any precise coal, one way out of the difficulty of getting the desired quality would be to go elsewhere for it, and pointed out that if the coal was crushed small it could be freed from impurities by washing. He also asked for some information as to the relative values of the products of distillation at different temperatures.

Mr. E. R. Dolby said that in his capacity as consulting engineer he had installed a number of CO_2 recorders, but had come to the conclusion that most of them were more suited for use in the laboratory than by the engineer in charge. He envied the author's results in the way of CO_2 in the waste gases, which rose to a maximum of 19.7 per cent., and asked how the records were obtained. With regard to variations in the dimensions of refractory bricks, he pointed out that in setting water-tube boilers it was often desirable to use more than one brand of bricks. Thus the greater part of the setting might be built with Stourbridge bricks, while some portions might have to be of Glenboig bricks, and two variations were thus introduced.

Professor J. W. Hinchley claimed that if purchasers really insisted they could get bricks which came up to the necessary standard, and complained that it was too often the custom to leave purchasing to men with no technical knowledge, who were more influenced by price than by quality. It was, he said, always good economy to buy the materials which most closely approached a given standard, as such a course resulted in a reduction of waste.

Mr. W. Newton Booth asked what method was adopted by the Newcastle laboratory in sampling the coal, as he had always found it very difficult to get a representative sample from a large consignment, and enquired if contracts with the collieries were based on the results of the tests. He also said that the variations in the dimensions of fire-bricks mentioned by the author were considerably greater than any he had experienced.

Mr. J. A. Reavell, chairman of the Chemical Group, spoke at some length on the necessity for co-operation between engineers and chemists, suggesting that both buyers and sellers of engineering commodities should each be assisted and guided by chemists. As an instance of a case in which such co-operation would have been advantageous Mr. Reavell mentioned

the purchase of a large evaporator. The buying department decided to take the lowest tender, as the manufacturer apparently gave just the same guarantees as his competitors. It was, however, pointed out by the engineering department that the lowest tenderer did not specify the temperature of the incoming liquid, while the others made their guarantees from and at 212 deg. F. On the other hand, he had some experiences in buying tubes for evaporating caustic soda, and had asked English manufacturers if their tubes were suitable for the purpose. The answer had been "buy them and find out yourself," which was, he thought, not at all a reasonable commercial proposition, specially in view of the fact that continental manufacturers, in quoting for tubes, gave a very precise statement of their resistance to corrosion by caustic soda.

Mr. E. A. Alliott said that he presumed one would find in a perfect world men who had a complete knowledge of both engineering and chemistry, but as that was not possible in this world the best that could be done was for two men to collaborate. One should be a thorough engineer with sufficient chemistry to be able to judge a chemist, while the other should be a chemist with a thorough knowledge of his art and good common sense. Such a chemist would be able to advise as to the effect of small variations in the raw materials on the product of a factory, and could often assist in maintaining the normal output. Suppose, for instance, soap ley had to be boiled down, a chemist could see that it was of the right consistency, and thus assure that the output determined by the engineers was maintained. Then, instead of it being necessary to install plants having sufficient margin of capacity to meet abnormal conditions, the size of the plant could be made to suit the required output exactly.

Mr. W. A. Tookey suggested that the language used by engineers and chemists was so different that it would be a great advantage if the two professions met more often, as they would then get a better understanding of one another. Such meetings also sometimes led to a shortening of research as one side or the other might be able to indicate a totally different route of investigation by which the desired end could be attained more quickly. He inquired if it would not be possible to reduce the irregularities in the quality of coal gas, which were accounted for, as the author said, by variations in the volatile constituents of the coal, by utilising the whole of the coal, coke and all, for making the gas.

Mr. L. M. Jockel agreed with the author as to the difficulty of buying a uniform quality of coal. His firm had to purchase some 50,000 tons of coal annually, and obtained it chiefly from the Midlands. During last year, excluding the three months of the strike, the average of daily analyses showed that the coal contained 11.3 per cent. of water, 24.2 per cent. of volatiles, 59.2 per cent. of carbon and 16.5 per cent. of ash. The corresponding minimum figures were 2.7, 23, 52 and 5.6, while the maxima were 19.6, 32, 69.9 and 32.2. With such a condition of affairs it was practically impossible to keep a steady output, and what was wanted was more co-operation between chemists and engineers as regards sampling and analysis. Mr. Jockel said that he had seen bricks which were worse, as regards their variation in dimensions, than those mentioned by Mr. Gill, and the bricklayers were spending about 10 per cent. of their time in sorting over the bricks. The percentages of CO_2 in flue gases mentioned in the paper were much greater than those a steam engineer could maintain, and, as a matter of fact, if the amount went above 14 per cent. trouble, was experienced with the refractories, specially if oil fuel was used.

Mr. W. H. Patchell emphasised the importance of chemistry in engineering by pointing out the great quantities of chemicals used in engineering works, and gave a list of such commodities used in America. Among them was sulphuric acid, of which 10 per cent. of the total production was absorbed by the steel works.

In replying, briefly, to the discussion, Mr. Gill said that the samples of coal taken at Newcastle were got by holding a bucket in the shoot down which the coal dropped into the steamer being loaded.

Manchester's New Outfall Sewer.

AT the outbreak of the war the Manchester Corporation was engaged in the construction, with its own staff, of a length of new outfall sewer to duplicate an already existing outfall sewer, and it was considered so important that the new sewer should be completed at the earliest possible moment, that permission was asked from the Government to construct the remaining length required to connect up the already completed portions of the work. This length, which is shown in Fig. 1, extends from the junction chamber to the second crossing of the Bridgewater Canal. The Government, however, refused to grant the permission asked for, and the work had to stop at the junction chamber, where the old and new sewers intersect as seen on the right-hand side of the engraving. As soon as was practicable after the cessation of hostilites, the corporation let a contract for the remainder of the work, operations being resumed in July, 1919, and finished in July, 1921.

The junction chamber—Fig 2, page 44—the construction of which was necessitated by the intersection of the new and old outfall sewers at practically the same invert level, is rectangular in shape, its internal dimensions being 98ft. by 32ft. 6in. It is covered by a semi-circular arch of six rings of brickwork, the haunches being backed up with concrete. The sewers enter and leave the chamber near diagonally opposite corners. Beyond it the new sewer proceeds in a north-westerly direction. It is 15ft. 3in. in diameter, is laid with a gradient of 1 in 2475, and has a discharging capacity of approximately 330,000 gallons per minute. The sewer—Fig. 3—is constructed of four rings of brickwork in cement mortar composed of two parts of sand and one part of Portland cement, the lower half of the inner ring or invert being built of red engineering bricks. Under the Cheshire Lines Committee's railway, the section of the sewer consists of five rings of brickwork with an invert of red engineering bricks, strengthened with cement concrete, this construction being adopted to comply with the requirements of the Railways' Committee.

Passing under the Bridgewater Canal, the circular section had to be abandoned in favour of twin culverts —Fig. 5—each 13ft. wide by 9ft. high, with a flat roof composed of rolled steel girders embedded in concrete; 1½in. mesh expanded metal was clipped on to the underside of the girders in order to make a strong bond for the concrete. The twin culverts combined have about the same discharging capacity as the 15ft. 3in. diameter outfall sewer. The inverts of these culverts are semi-circular, with a radius of 2ft. 9in., sloping benchings, 3ft. 9in. wide, being formed on each side, in order that the velocity and depth of flow in the culverts may correspond with the velocity and depth of flow in the sewer during dry weather to prevent any silting in the culverts.

The work under the canal was carried out one half at a time, without any interference with the traffic on the canal. A cofferdam consisting of a single row of piles was first constructed over the easterly half of the waterway, leaving a width of 17ft. open for the passage of barges. The piles were of pitch-pine, 10in. by 6in., bolted together in pairs and shod with wrought iron shoes driven about 10ft. deep into the clay bed of the canal. The twin culverts were next constructed, and shortly afterwards the piles were drawn. The westerly portion of the canal was then cofferdammed in a similar manner to the easterly half, except that the bottoms of the piles over the culverts had square ends, which were fitted into concrete grooves already built on the roof of the completed culverts. When the cofferdam was completed, the traffic in the canal ran over the completed portion of the work while the second half of the culvert was constructed within the cofferdam in a similar manner to the first half.

A large storm overflow chamber was constructed at the junction of Westinghouse-road and First-avenue. This chamber allows a definite amount of storm-water to overflow into the Manchester Ship Canal. In it there is a large cast iron storm-water carrier—Fig. 6—weighing about 50 tons which can be raised or lowered by mechanical means, so that as the population increases and the dry weather flow also increases, the storm-water carrier can be raised, thus regulating the amount of storm-water which can be discharged from the main sewer. The carrier is built up of cast iron segments, 1¼in. thick, bolted together. It has a flat-bottom and a semi-elliptical top, the bottom being covered with fine concrete, so as to give a smooth surface to the flow. At the upstream end the bottom plates have sharp edges. The raising of the carrier is provided for by four hydraulic jacks, cast iron boxes for the reception of which are provided at the corners of the carrier. Just adjacent to the storm-overflow chamber—the construction, in fact, forming practically part of the chamber —the new outfall sewer is carried over an existing storm-overflow chamber 9ft. diameter. The new sewer is carried across this storm-water sewer in a cast iron conduit—Fig. 7—the latter sewer being reconstructed to pass under it. The roof of the storm-overflow chamber is constructed of rolled steel girders and concrete in a similar manner to that of the canal crossing. On leaving the storm-overflow chamber, the new sewer is only 13ft. in diameter, and continues of that section to the Bridgewater Canal.

The work has been carried out in open cut throughout, and no mechanical contrivance was used for excavating. Materials were lifted from and lowered into the trench, except for one short length, by means of steam cranes, and surface haulage was effected by means of a temporary standard gauge railway running alongside the trench. Convenient tips for the surplus material were available in the vicinity of the works. In most cases there was ample space alongside the trench for the temporary railway and also for the materials. This was not so, however, in the length between the Bridgewater Canal and the overflow chamber, and in that case the materials were lifted and conveyed by a 1½-ton electric motor transporter on a run-way fixed to the underside of the top cross members of a gangway spanning the trench. A 6in. subsoil drain was laid below the level of the sewer to drain subsoil water into sumps from which it was pumped by electrically driven centrifugal pumps. All the subsoil water occurred, fortunately, in the upper strata and ran down behind the timbering into a channel or "garland" formed in the clay above springing level. The water in the garlands was conveyed by 3in. tile drains, laid in chases immediately behind the brickwork to 3in. junctions on the subsoil drain. This enabled the brickwork to be constructed in the dry. The subsoil trench was covered over with concrete and the sumps were also filled up solid with concrete when they were no longer required. The strata met with in the construction of the sewer were alluvial deposits overlying the new sandstone of the upper series of the coal measures. From the surface downwards the strata were soil, peat—except at the eastern end—sand, gravel and stiff clay. The top of the clay is in some places above the crown of the sewer and the lowest level at which it occurred was about springing level. The work was carried out under the direction of the City Engineer, Mr. J. B. L. Meek, M. Inst. C.E., by Messrs. Edmund Nuttall and Co., contractors, of Trafford Park, Manchester.

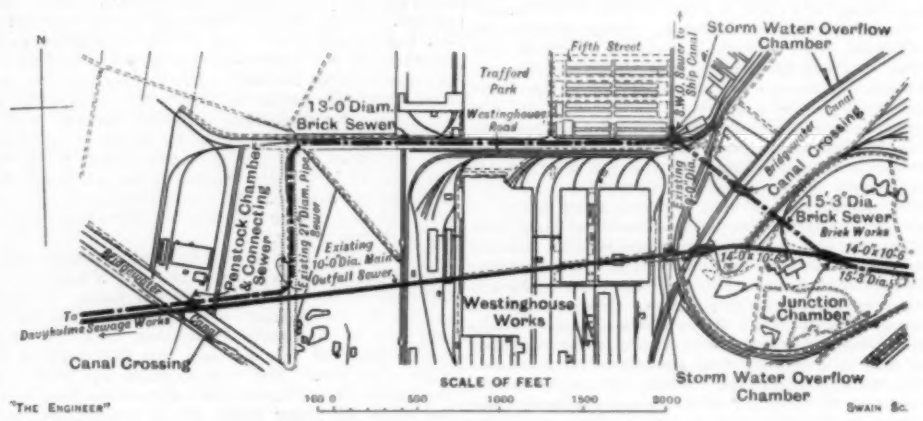


FIG. 1—PLAN SHOWING A PORTION OF MANCHESTER'S NEW OUTFALL SEWER

EDUCATIONAL INTELLIGENCE.

DR. BRYSSON CUNNINGHAM has been appointed Lecturer on Waterways, Harbours and Docks at University College, London, for the present session. He will begin a course of lectures on waterways, harbours and docks on Tuesday, January 24th, at 4 p.m. The course, which will be continued on Tuesdays and Fridays at 4, deals with ports, harbours, docks, inland waterways and maritime structures. Full particulars can be obtained from the Secretary, University College, London, W.C. 1.

THE Department of Coal Gas and Fuel Industries with Metallurgy of the University of Leeds has arranged the following programme of special courses for the current session:—I., The Manufacture of Coal Gas: A course of twelve lectures will be given by Dr. H. G. Colman on Fridays at 6 p.m. and 7.15 p.m., commencing January 20th, and concluding February 24th. Ia., Recording Gas Calorimeters: Two lectures will be given by Mr. J. W. Wood at 6 p.m. and 7.15 p.m. on Friday, March 10th. II., Refractory Materials: A course of eight lectures will be given by Professor J. W. Cobb on Tuesdays at 6 p.m. and 7.30 p.m., commencing January 17th, and concluding February 7th. III., Metallurgy: A course of six lectures on the microscopic study of engineering alloys, followed by practical work in the laboratory will be given by Mr. P. F. Summers on Wednesdays at 6 p.m., commencing January 18th, and concluding February 22nd. IV., Evening Laboratory Course: The laboratory of the Department will be open on Wednesday evenings between 6 p.m. and 9 p.m. from January 18th to February 22nd, for a limited number of students who have already received some chemical training, but who desire instruction in fuel calorimetry and pyrometry. More advanced students, capable of independent work, may also be admitted to the laboratory during these periods. V., Day Lecture Courses in the properties of gases, the technology of fuel, general and non-ferrous metallurgy, iron and steel, and alloys and metallography. Further particulars may be obtained by application to the Registrar, the University, Leeds.

A Seven-Day Journal.

Wages of Railwaymen.

FAR-REACHING results may follow the inquiry on wages which commenced in London on Wednesday before the National Wages Board to deal with differences which have arisen between the Scottish companies and the National Union of Railwaymen. It will be recalled that owing mainly to the high percentage which wages bear to total costs of operation, Scottish railways have refrained from granting the concessions in goods rates which came into force on English and Welsh railways on January 1st. The request of the Scottish companies was for the withdrawal of the wages increase granted in May, 1920, estimated at an average of 5s. per week, quite independently of the fall in wages resulting from the operation of the sliding scale arrangement. A demand was also formulated for the modification of the eight-hour day arrangement, which has hit all railway companies very hardly, but Scottish railways more than those in England and Wales. It is common knowledge that with some classes of railway workers the eight-hour day is unpopular, and is difficult to arrange. Manufacturers and traders will await the result of this appeal with much interest, as it is notorious that it is only the high rates of wages and conditions of working which have prevented railway companies making the concessions in rates which have been demanded and are still being pressed for by traders' organisations.

Wood-Working Machinery Regulations.

As a result of representations made by employers it is announced that considerable modifications are to be made in the regulations for the use of wood-working machinery, which were issued on the recommendation of the Joint Industrial Council for the Building Trade. The revised regulations have just recently been issued and will, it is believed, go far to meet the objections which have been raised and obviate the need for the informal inquiry which must otherwise have been held.

The Port of Kosi.

IT is understood that plans for the establishment of a new port at Kosi Bay are before the South African Government, the intention being to provide a new outlet which at present passes through the Portuguese port of Lorenço Marques some 300 miles distant from Durban. As a result of surveys along the coast, there appears to be a unanimity of opinion among experts that the most favourable site for a new port is at Kosi Bay, in northern Zululand, a position which at one time was under the consideration of President Kruger's Government. It is stated that a port accessible for vessels under all conditions could be constructed for a comparatively small capital outlay. Surveys have also been made for a railway over a length of 130 miles to give communication from the South African Railway system to Kosi Bay, which would serve to open up a large area of almost virgin country.

Styrian Water Power Works.

A COMPREHENSIVE plan for the development of water power in Styria is the subject of a report which has just been made by the engineer of the Public Works Service, Mr. Hofbauer. Investigation has shown that it is in this province that the chief Austrian water powers are situated. The Provincial Government has reserved the right of granting concessions and has combined all important water-power concessions similar to a monopoly in a limited company in which the Provincial Government is a shareholder. The scheme is that a combined working of all the valuable water powers should be arranged in such a manner that plant on rivers, the flow of which varies considerably, will be supplemented by storage plant in the mountains and further reserves supplied by steam plants in brown coal pits. The total concessions to be exploited should provide 450,000 horse-power, which is about the fourth part of all the water powers in Austria that can be developed. The building of the works and plant is to be completed within fifteen years. A market for the current is said to be assured for industrial requirements, particularly for the iron industry and the railways, as well as in the large cities, including Vienna. This is the first great financial operation which has been carried through in Austria since the termination of the war.

Needs of the Universities.

ATTENTION may be directed to a joint memorandum to the Prime Minister from the sister Universities of Birmingham, Leeds, Liverpool, Manchester, Sheffield and Durham urging the dangers of any reduction in the grants made to Universities and colleges of University status. It is pointed out that the funds now provided out of State resources have been reduced to the lowest level at which the due discharge by the Universities of their duties to the nation can be guaranteed, and that any further retrenchment would not only be harmful of public interests but wasteful of the outlay already made. The Prime Minister is reminded that all possible economy in expenditure has been made and every effort of self-help exhausted and all avenues from which aid might be obtained explored. Fees have been raised, collections to an amount of over one million pounds made from private benefactors, and local authorities induced to make large grants. In other countries, we are told—notably in Germany—renewed efforts have been made since the war to strengthen the resources of Universities and to use them as centres of training for the professions, responsible posts in industry and commerce, and for the public service. We know, too, that in the United States the endowment of Universities has been on a lavish scale, and that gifts in aid of education are a feature of modern American life. The appeal to the Prime Minister is strengthened by the fact that the Vice-Chancellors of the Universities of Oxford, Cambridge, London, Bristol, Glasgow, Aberdeen and Wales have expressed their concurrence in the arguments advanced of a more liberal interpretation of the responsibility of the State towards education. It is hoped that the intention to reduce the University grant for the year 1921–22 by £300,000 will be abandoned.

Berlin—New York Air Service.

THE rumour which was assiduously circulated after the disaster to the R 38 that the United States Government would acquire a Zeppelin from Germany is now confirmed. Work on the construction of the airship is to be put in hand immediately, and plans are taking shape, not only for airship services between New York and Chicago, but possibly for an extension to Berlin. A study of the whole subject has been made by German aeronautical engineers, and ambitions are entertained of regular Transatlantic services for goods, passengers and mails.

Future of Haulbowline Dockyard.

WHILE other dockyards are clamouring for Government work, Haulbowline will, in consequence of the new condition of affairs in Ireland, be vacated by the Admiralty. The yard will be stripped of all its machinery and handed over to the new Irish Government, and its future *rôle* is a matter of speculation. The large number of apprentices who were undergoing their training at Haulbowline will be transferred to English and Scottish naval dockyards.

Nottingham Waterways Improvement Scheme.

MUCH interest has been aroused at Nottingham by the visit of inspection to the canal improvement works on the Trent Navigation which is being paid to-day by Mr. Neville Chamberlain, the chairman of the Ministry of Transport Canal Committee. Powers to enlarge the locks and generally to improve the Trent Navigation with the object of enabling larger boats than can now be accommodated to make the through journey to Nottingham have been possessed by the Corporation for some years past. Under existing conditions there is no certainty that a barge carrying 70 or 80 tons from the port of Hull to Newark or Nottingham can reach its destination without being lightened. Mr. Chamberlain's Committee, in recommending the carrying out of a small-scale improvement scheme, selected the Trent Navigation for this purpose, and the work now being carried out by the Nottingham Corporation fits in with that outlined in the Canal Committee's report.

Contract for New Thirlmere Pipe Line.

PENDING the carrying out of the new scheme for drawing supplies from the Lake district, the Manchester City Council has placed contracts for the fourth pipe line from Thirlmere. There was considerable variation in the prices quoted for a part of this work, but it is understood that the tender accepted—that of the British Mannesmann Tube Company—was much lower than any other. Its adoption by the Council is associated with a provision that a series of tests of the welded steel tubes which would be used for the work shall be carried out. This seems to be only an ordinary precaution in dealing with engineering material, but perhaps the tests are to be of a more than ordinarily stringent character.

Shipyard Costs and Wages.

THE issue this week of the shipbuilding returns for the last quarter of 1921 is very opportune. The scarcity of work in the shipyards revealed in the official statistics may perhaps have an effect on the course of the deliberations between shipbuilding employers and workers' representatives which will take place at Carlisle next week. The notice convening the Conference indicates that the business to be discussed is the continued depressed state of shipbuilding and the methods by which, without inflicting any unnecessary hardship on the men, the war bonuses may be withdrawn. It is quite obvious that the concurrence of high shipbuilding costs and low freights is keeping shipowners out of the market, is causing work on ships already laid down to be suspended, and is the main factor in the present slump in shipbuilding. Those who assemble at Carlisle next week must face these unpleasant facts and find the remedy for a condition of affairs which is reducing a great industry to a state of stagnation.

Explosion on Midland Locomotive.

IT is a remarkable fact that the practical immunity from accidents due to the bursting of engine boilers or explosion arising from other causes by which British railway working was distinguished for so many years should have been broken twice within a short period. As to the precise cause of the accident on the Southend section of the Midland Railway on Wednesday last, judgment must be reserved, but a preliminary examination of the engine appears to have made it quite clear that an explosion had taken place. The driver of the engine was unfortunately killed, but it may be possible for the fireman who is at present in hospital to throw light on this disquieting incident. A more serious accident was perhaps averted by the fact that, arising perhaps from a sense that something was wrong, the enginemen applied the brakes before the explosion occurred, and brought the train to rest.

Crinan Canal Improvement Scheme.

IF the larger of the two schemes for the improvement of the Crinan Canal outlined in the report of the Ministry of Transport Committee is carried out, this waterway will become an important link in the transport system between the Clyde and the Islands and the West Coast of Scotland. In the existing canal the passage of the waterway is limited to vessels in the loaded condition not exceeding about 66ft. in length and of 100 tons deadweight, and unless urgent repair works are put in hand without delay, the Canal will become derelict. The minor scheme, of which details are given in the report, would include extensive lock repairs, re-pitching in the east reach, repairs to walls and waste piers in the west reach, and reduction of the more serious rocky corners which are a danger to navigation. These works would at present prices cost about £192,000, and would occupy 2½ years, and the Canal would have to be closed to navigation for twelve months at one stage. The more ambitious improvement, which would make the Canal navigable by vessels 125ft. long, 21ft. beam, 10ft. 6in. draught, and a cargo-carrying capacity of 250 tons, would cost £700,000. Under this plan the summit level would be reduced from 65ft. to 31ft., eight locks dispensed with, and the western reach abandoned in favour of a new channel from Dunardy to Loch Crinan. Whether the larger scheme will be approved by the Government is doubtful, as it is quite clear that it would have to foot the bill, and economy in public expenditure is the order of the day.

Rating of Machinery.

THE principal subject discussed in the report of the Council of the Machinery Users' Association for the years 1920 and 1921, which is to be submitted at the meeting next week is the rating of machinery. It is pointed out that the position of affairs with regard to this important question involves serious consequences for the users of machinery throughout England and Wales. It will be recalled that some time ago the Poor Law Union Assessment Committees of Lancashire held a conference, at which it was decided that the value of machinery should be included in the assessment to local rates. At a later date the National Conference of Assessment Committees carried a resolution hostile to the Bill then before Parliament, asking for the exemption of machinery from local rating. The policy dictated by the action of these committees is stigmatised in the report of the Association as an attack on both capital and labour, and a direct burden on the industries of the country. An appeal is therefore made for support for the Bill to obtain relief which is being promoted.

New Steel Works at Dowlais.

THE foundations are now being put down for a new steel railway sleeper mills by Guest, Keen and Nettlefolds, Limited, at Dowlais. The scheme is a somewha important one, and it is anticipated that when the new works and plant are ready to be put into service at the end of the present year they will replace the existing mills.

The Physical and Optical Societies' Exhibition.

No. I.

OF the various exhibitions which are organised at different times of the year, few, if any, are more interesting and instructive than the exhibition of electrical, optical and physical apparatus which is held under the auspices of the Physical and Optical Societies at the Imperial College of Science. On Wednesday and Thursday of last week the instrument makers and kindred firms which usually display their goods on these occasions were again in evidence, and although many of the exhibits did not differ widely from those which were displayed on the previous occasion, the show was not by any means devoid of originality. Novelties in the form of electrical instruments, which incidentally were much more numerous than other instruments, were to be found on a fair number of the stands. The Cambridge and Paul Instrument Company was showing, as usual, a large collection of instruments, and some of them had never been exhibited before.

The Cambridge string electrometer, originally suggested by Professor Einthoven, is an instrument having a moving system composed of silvered quartz fibre, which is stretched between and is parallel to two fixed metal plates. Not only is the capacity of the instrument very small, but the motion of the fibre is dead beat and the period is short. The instrument is therefore very suitable for following or for recording with the aid of a camera rapid changes in voltage met with in the study of discontinuous phenomena such as are experienced in experiments in connection with the ionisation of gases. The minute force that is sufficient to deflect the silvered quartz fibre, namely, about 10^{-8} dynes, is of the same order as that acting on the gold leaf of the most sensitive of the usual gold leaf electroscopes. Each end of the quartz fibre is attached to a flag anchored to an amber block by means of a brass clip, the flags being held in the clips by a screw so that the fibre can be changed without difficulty. The upper amber block is held in a fixed position, whilst the lower block is carried on a rocking arm, which is controlled by a micrometer screw at the right side of the case. To tighten the fibre the head of the screw is turned clockwise. The two parallel metal plates are secured on either side of the fibre with a distance of 4 mm. between them by means of ivory blocks, and the position of the plates in relation to the fibre may be altered in a lateral direction by the screws P and P^1, shown in Fig. 1. This lateral movement of the plates enables the operator to ensure that the fibre is situated in the electrical centre of the system where the deflection of the fibre is equal in either direction. The terminal F is connected to the upper end of the fibre, whilst the terminal F^1 is connected to the brass case, which is earthed. At the back and front of this draught-proof case there are windows. Through the back window light is thrown on to the fibre by a mirror attached to the stand, whilst the front window serves for observing the fibre with a microscope having a finely adjustable forward and lateral movement. For projection or photographic purposes the mirror is removed and an optical condenser is fitted to the back window to allow more concentrated lighting to be thrown on to the fibre from an arc or pointolite lamp.

The disappearing filament pyrometer shown in Fig. 2 has been designed to work with a current of .5 ampère. Inside the instrument is an electric lamp which is connected in series with a small ammeter calibrated in degrees Centigrade and a 2-volt accumulator. The observer looks at the hot body it is desired to test for temperature through the eye piece in front of the instrument, and adjusts the current by means of a rheostat until the tip of the filament is at the same brightness as that of the hot body, when the temperature is read from the scale of the ammeter. The standard ranges for which these instruments are made are from 700–1400 deg. Cent. and 900–2000 deg. Centigrade, and by means of stops immediately behind the eye piece, different glasses are introduced into the optical system to facilitate the observation of the filament and hot body at different temperatures. A new thermo-couple pyrometer, which is shown in Fig. 3, has been designed by the company with a view to eliminating the various sources of error which usually occur when working without a potentiometer. Advantage is taken of the resistance changes in the circuit to compensate for the changes of current the "Moll" galvanometer, which is very suitable for use with thermo-couples. The moving coil in the electromagnetic field is quick in action, for it reaches its final position to within less than a millimetre for a total movement of 200 mm. in approximately 1.5 seconds. A micro-ampère gives a deflection of 200 mm. at a distance of 1 m. The string galvanometer shown in Fig. 6 is a simple form of Einthoven galvanometer with copper fibres .01in. in dimeter. The magnification is about 40 at a working distance of 80 cm., which is a suitable distance for photographic purposes. The instrument can be used in conjunction with the large type of Einthoven galvanometer, fitted with a silvered glass fibre, when the optical work in the small instrument forms the eye piece of the large one. An electro-cardiogram, a phon-cardiogram and a pulse tracing can be produced on the same plate.

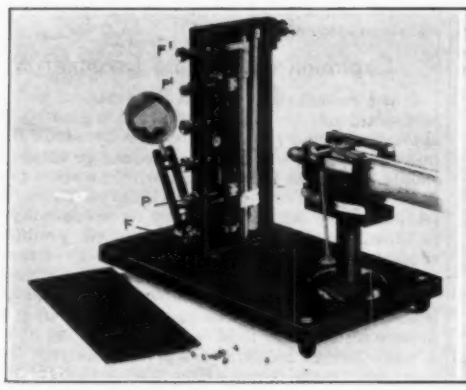


FIG. 1—THE CAMBRIDGE STRING ELECTROMETER

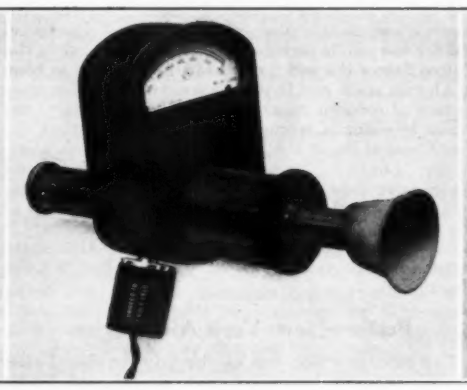


FIG. 2—DISAPPEARING FILAMENT PYROMETER

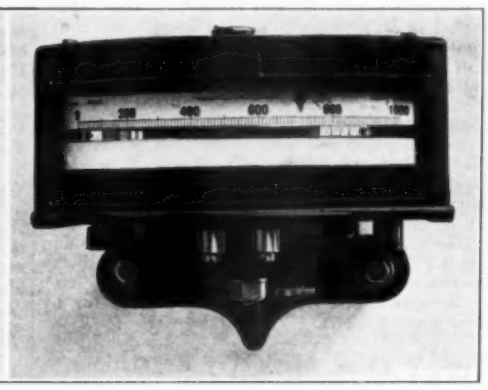


FIG. 3—THERMO-COUPLE PYROMETER

An optical pyrometer of the disappearing filament type, exhibited by H. Tinsley and Co., of South Norwood, operates on a novel principle, which will be understood from Fig. 7. The pyrometer lamp C is connected in one arm of a bridge which has ratio arms A and B composed of manganin. The resistance D, which is also made of this material, is adjusted so that with the lamp running at any particular temperature, say, 700 deg. Fah., the bridge is balanced. The zero of the galvanometer scale therefore corresponds to a reading of 700 deg. Cent. If the current in the bridge is increased the temperature of the lamp increases, and also its resistance, and if the other resistances remain unchanged this will cause the galvanometer to give a deflection. The resistance E which controls the sensitivity of the galvanometer, is fixed at such a value that the extreme end of the scale is made to correspond with a certain upper limit of temperature, say, 1300 deg. Cent., and the desired temperature range of 700–1300 deg. Cent. is made to fill exactly the whole length of the scale. The makers point out that when the indicator of a pyrometer of this type is simply used as an ammeter to record the current values corresponding to the temperature the scale is very cramped, and this has led instrument makers to adopt the expedient of setting back the zero of the indicator so as to spread their scales; but this practice presents the disadvantage of placing the spring of the instrument under a permanent stress, and the true zero of the instrument cannot be checked. The scale of an instrument used in the manner described can be further extended by reversing the polarity of the battery.

The most novel device shown this year by the Foster Instrument Company, of Letchworth, Herts, was an automatic apparatus for controlling temperature in accordance with a pre-determined programme. In certain manufacturing processes it is

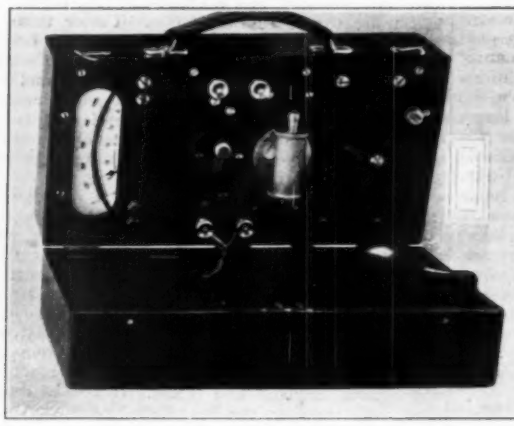


FIG. 4—PORTABLE CO_2 AND TEMPERATURE INDICATOR

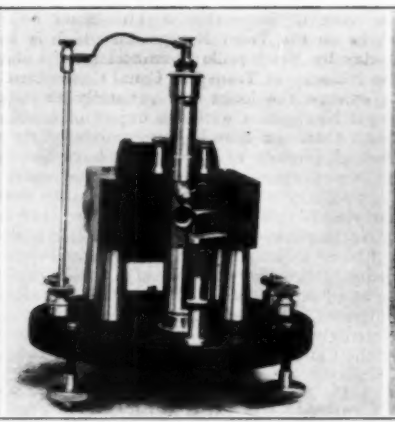


FIG. 5—THE MOLL GALVANOMETER

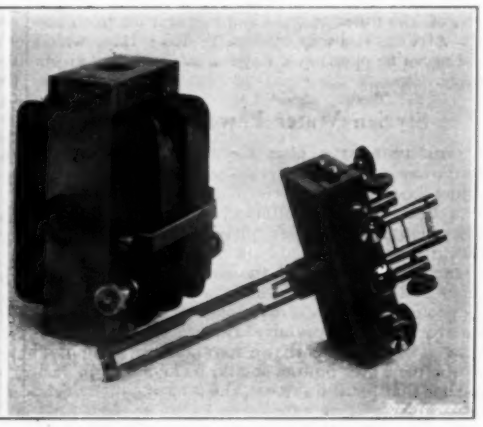


FIG. 6—STRING GALVANOMETER

The company's new portable CO_2 and temperature indicator, which was also exhibited, is shown in Fig. 4. The apparatus works on the electrical principle which we have previously described—see THE ENGINEER, October 1st, 1920—and the catharometer and filter are inside the case. When it is desired to take measurements it is merely necessary to connect the instrument up to the flue and to join the thermo-couple to the couple terminals. The gases are drawn up by squeezing the rubber bulb to be seen inside the case. Two galvanometers exhibited by the company are shown in Figs. 5 and 6. The former is

essential that the temperature of an electric furnace should rise fairly rapidly to a certain low value, should be maintained at or near that value for a considerable period, and should then be rapidly raised to a higher value, which should also be maintained for a certain period, and then be slowly reduced. The new apparatus introduced by the above company is designed to bring about these conditions automatically. A thermo-couple is inserted in the electrically heated furnace, and it is connected to a recorder with its pen actuated by a moving coil permanent magnet millivoltmeter. The movement of the pen is therefore proportional to the furnace temperature. By means of clock mechanism inside the recorder, the pen is pressed alternately on the ink drum at the side of the chart and on the chart itself, and after the pen has been inked it is free to make a deflection proportional to the temperature of the furnace. Over the chart there is a metal template which is cut to the shape of the required temperature record, and when the temperature of the furnace is below that desired the pen makes contact with the template and completes an electric circuit through a relay. This relay operates an electric motor which reduces the amount of resistance in the heating circuit and thus increases the furnace temperature. After this operation, the pen, having been moved over to the ink drum, completes another electric circuit, which operates another electric motor, which increases the resistance in the heating circuit. The decreased heating effect, however, is always less than the increased effect, so that as long as the temperature is below the pre-determined value, which is determined by the shape of the template, there is a tendency to decrease the electrical resistance and to increase the furnace heating effect. When, however, the temperature has risen above that determined by the template, no electrical contact is made when the pen is depressed on the paper, but there is still a repetition of the contacts which decrease the heating. The arrangement will indicate on the chart the times when the temperature exceeds the desired value, and if the template is perforated a record can also be obtained of the times when the temperature was below the proper value.

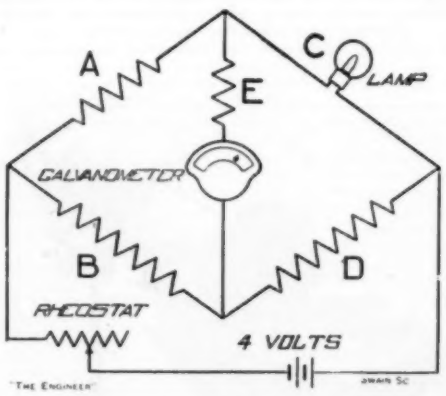


FIG. 7—CONNECTIONS OF TINSLEY OPTICAL PYROMETER

Developments in Power Station Design.

No. XXII.*

THERE are of course various forms of water-tube boilers which, although seldom seen in power stations in this country, have met with success in stations abroad. One of them is the Kestner boiler, which since its introduction has, it is said, acquired favour in France, Belgium, Denmark, Germany, Russia and the Argentine. Hitherto this boiler has been manufactured by Schneider and Cie., but just recently the sole selling and manufacturing rights for Great Britain and Ireland, the British Dominions, Colonies and Dependencies, China, South Africa and the Dutch Indies have been acquired by Ransomes, Sims and Jefferies, Limited, whose works at Ipswich include a large boiler department which is well laid out to cope with work of this class. The boiler consists, as shown in Fig. 107, of an upper steam drum and a lower mud drum, which are connected together by a double row of tubes which are expanded at their ends. The steam drum, it will be perceived, is of larger diameter than the mud drum so as to provide a large steam reserve. The holes in both drums are accurately machined to receive the tubes, which are not only vertical and absolutely straight, but as will be seen from Fig. 108, are arranged along the drums in the form of a repeated letter W. Further, it should be noted that in order to secure advantages which will be referred to later there are only two rows of tubes. The evaporating tubes A either have a diameter of $2^{9}/_{16}$in. or $2\frac{1}{2}$in., according to the size of the boiler. At about the longitudinal centre line of the boiler there is a number of larger tubes B, with a diameter of $3\frac{1}{2}$in. or 4in., and inside these tubes smaller concentric tubes C are suspended by means of three-point supports. At the top these small tubes are cone-shaped, whilst at the bottom they are straight and project into the mud drum so that they nearly touch the deflector tray D.

For the purpose of securing uniform distribution of the feed water along the drum, the water is introduced into a tray E, from which it overflows at numerous points. The comparatively cold water passes downwards through the circulating tubes C, and on striking the deflector tray D it has its velocity reduced before its return to the steam drum by way of the evaporating tubes A and B. The two rows of tubes arranged in the repeated letter W fashion are placed so that the tubes in one row are staggered relatively to those in the other row in order that under working conditions every tube may be equally heated and subjected to uniform expansion and contraction. Tube hogging is said to be unknown. The small circulating tubes C which are inside the large evaporating tubes are surrounded by water at the boiler temperature, and as they are not in contact with the hot gases they cannot produce steam. By this arrangement a definite circulation is assured, and the efficiency of the circulation can be gauged from the fact that the velocity of the water down the circulating tubes is about 80ft. per second. This high velocity, it is claimed, makes it impossible for any deposit to form on the interior surface of the tubes.

Many boilers have worked for periods of more than three years with water having hardness of over 35 deg. (Clark's scale) without it being necessary to scrape the tubes. After the water has passed downwards through the circulating tubes into the deflector tray D, its velocity is so reduced that on passing into the lower part of the mud drum any scaling matter in suspension falls to the bottom and may be discharged through the blow-off at suitable intervals. In the return path for the water to the steam drum through the evaporating tubes A and B, the ratio of the volume of steam to water is approximately one to eight, and as the volume of steam in these tubes is comparatively small, there is no risk, the makers point out, of damaging the tubes, even when evaporation is forced to the extreme limits. In one instance, we are told, a boiler of this type was known to have worked for a considerable period with an evaporation equivalent to $12\frac{1}{2}$ lb. of water from and at 212 deg. Fah. per square foot of heating surface, and without detrimental results. This evaporation is equivalent to the transmission of 12,200 B.Th.U. per hour, or 74 per cent. in excess of what the makers consider to be the usual working rate of most water-tube boilers in this country.

As regards accessibility, it is merely necessary, when it is required to inspect the parts or to carry out repairs, to remove two manhole covers. The exterior portion of the tubes may be inspected and cleaned through openings in the back brickwork as shown, for example, at F. The work of opening up the boiler ready for cleaning or inspection is very simple, and can be carried out in a short space of time, whilst the cost of labour is not great. Moreover, owing to the arrangement of the tube elements any tube can be removed and replaced without in any way interfering with adjacent tubes. From Fig. 107 it will be seen that the grate is placed on a level with the lower drum, which is shielded from the heat radiated from the fuel bed and from the hot gases by a fire-brick wall G. Over the grate is an inclined arch H, which is continued up to the tubes and is fitted into the V-shaped recesses formed by the latter by fire-clay slabs, which rest on the end of the brick arch.

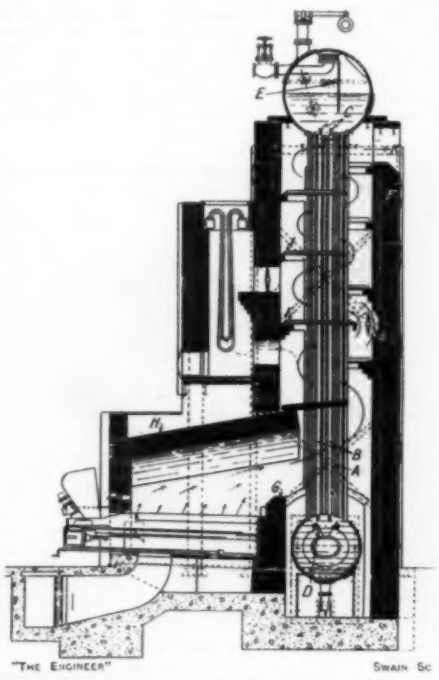


FIG. 107—SECTION THROUGH KESTNER BOILER

At suitable intervals above this arch there are cast iron baffles I which are similarly shaped, and the hot gases are made to zig-zag their way through the tubes to the outlet gas K. In most designs of water-tube boilers it is possible to arrange the grate of the furnace directly under the tubes, so that the hot gases rising from the fuel bed impinge almost immediately on the first tube sections. When burning a high-grade fuel, namely, anthracite coal, this arrangement the makers of this boiler explain, is satisfactory. Most water-tube boilers are, however, required to work with bituminous coal, which as often as not is of a low grade character. The furnace with a grate immediately under the tubes is not, however, considered suitable for use with such fuels, as owing to the cooling effect of the tubes, the temperature above the fuel bed cannot be maintained at a sufficiently high value to ignite and burn the volatile hydrocarbon gases evolved from the fuel bed by the heat of combustion. Consequently in order to obtain reasonable efficiency it is considered necessary to adopt for bituminous fuels the reverberatory type of furnace as shown in Fig. 107.

Owing to the general construction of the Kestner boiler the external type of furnace is the only type that can be employed, but it can be adopted to suit any type of mechanical stoker for burning any class of fuel. On account of the reverberatory effect of the long arch over the grate a high temperature is maintained and complete combustion of the volatile constituents of the fuel is secured before they reach the tube surfaces. It is necessary, in order that the boiler efficiency shall be high, that the furnace temperature shall be high, whilst the temperature of the gases leaving the boiler must, of course, be relatively low,

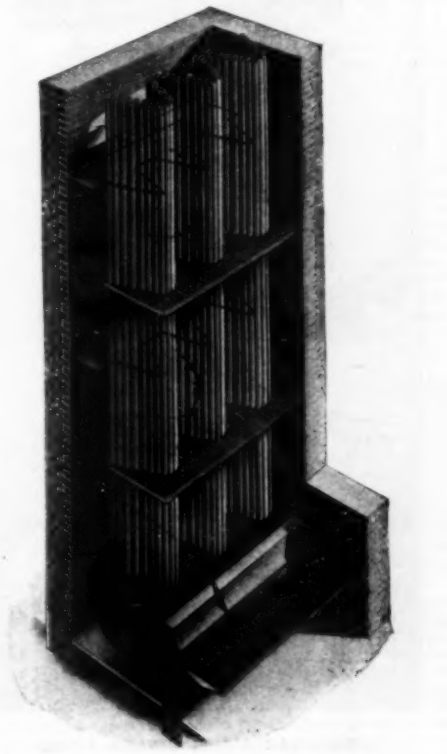


FIG. 108—ARRANGEMENT OF TUBES IN KESTNER BOILER

and with the Kestner boiler it is possible to vary the number of baffles in order that the temperature of the gases may suit individual requirements. In places where economisers are not provided the temperature of the gases leaving the boiler can be reduced to within 200 deg. Fah. above the temperature of the water inside the boiler. The boiler can, of course, be fired with all kinds of liquid and solid fuel, and it is equally suitable for use with uncleaned gas, because the vertical tubes are to a large extent self-cleaning. The dust falls into the soot pit below the mud drum, from which it can be removed whilst the boiler is at work. Another advantage which is claimed for the boiler is that when it is worked with hot waste gases there is a considerable saving in floor space as compared with that required by other boilers of the same capacity. Almost any type of superheater can be fitted to the boiler; and in the case of the arrangement shown all the joints are accessible whilst the boiler is under steam. In one of the new French power-houses sixteen Kestner boilers, with a total evaporative capacity of 400,000 lb. of steam per hour, are in use, and sixteen similar additional boilers are to be installed.

* No. XXI. appeared December 30th.

IN the destructive fire of the 4th inst. at Hartlepool, the North-Eastern Railway Company's sleeper yard was affected. It is officially estimated that 330,000 sleepers were destroyed.

The Model Engineer Exhibition.

IT is now eight years since an exhibition of engineering and scientific models was organised by the *Model Engineer*, and the present exhibition, the fifth of its kind, which was opened on the 7th inst., and closes to-morrow, January 14th, is fully as interesting as any of its predecessors.

The idea once very largely held that model engines were only toys, which resulted in burnt carpets, or soiled tablecloths, is fast dying out, and the art of model making is securing more serious interest, for, apart from the training thus obtained by the younger generation, the historical value of models must not be lost sight of. Our knowledge of many early engines is largely based on contemporary small-scale models, and it is quite possible that the models of to-day may be equally interesting in the future. But the production of a true model of a modern machine is naturally a much more serious undertaking than it was, say, a hundred years ago, with the result that the appliances required are more elaborate, and it is with this side of the subject, rather than with the models themselves, that we will deal here.

Before, however, going on to describe some of the tools at the exhibition, we would like to mention one of the models, as it stands out prominently among all the others. It is on the stand of Percival Marshall and Co., the organisers, and represents an old-fashioned entablature pumping engine. The model

CHELTENHAM 4½-INCH CENTRES LATHE

was probably made between 1830 and 1840, and was only discovered in a disused loft a year or so ago. It has needed very little renovation, and illustrates very plainly the style of design then in vogue. The original of the model probably had a cylinder 12in. in diameter by 24in. stroke, and developed about 20 indicated horse-power when working with steam at a pressure of 30 lb. per square inch.

Reverting to the workshop equipment on show at the exhibition, it is noteworthy that the machine tools are almost entirely lathes. There are one or two hand-driven shaping machines and a few small drilling machines, but it is evident that few model makers consider the expenditure on a shaper or planer to be justified. Among the lathes there are, of course, the Drummond 4in., with the cylindrical bed, and the 3½in. back geared machine by the same makers, but both these tools are so well known as to need no description here. There is, however, an almost miniature lathe, also made by Drummond, which is exhibited for the first time. It is the little machine to which we referred to as being in preparation about two years ago, and to the commercial engineer looks little more than a toy. The fact that some thousands have already been sold indicates, nevertheless, that it must be quite useful in its way. The height of the centres is 2in., and it will swing 5in. over the gap, while the length between the centres is 5in. It has a single-geared headstock with three speeds, and a compound slide rest. The slides of the rest are ingeniously contrived with turned bars, instead of planed guides, and several other ideas have been adopted to reduce the cost of manufacture without imperilling accuracy, with the result that the lathe can be sold very cheaply. A scheme has also been evolved for converting the lathe into a drilling machine or a vertical miller. For these purposes the bed is raised up on end and fixed in a simple bracket bolted to the bench, while guide pulleys for the driving band are attached at the headstock end. For drilling a table is then fixed on the tailstock spindle, or, if milling is to be done, the slide rest is fixed to the tailstock.

The lathe shown in the illustration, which is made by Cheltenham Works, Limited, of 86, Acre-lane, Brixton, is a substantially built machine with 4½in. centres and a gap that accommodates a diameter of 11in. The distance between the centres is 24in., and the spindle has a ⅜in. hole bored through it. It will be noticed that only two speeds are provided on the belt pulleys, but we found, when trying the lathe on the stand, that ample purchase is provided for taking a good heavy cut on a diameter of about 4in., and there did not appear to be any appreciable spring in the bed and slide rest. One of the lathes on the stand is fitted with a new milling attachment which has just been brought out by the makers The attachment consists of a rigid vertical shaft firmly attached to the rear of the lathe bed and farther supported by a bracket on the chip tray. The movable head slides on this shaft on a keyway, and can be clamped at any level to give the rough adjustment for height. The head has accurately formed slides on which the operating head and spindle move in a vertical direction, the feed being governed by a feed screw with a micrometer adjustment. The spindle nose is bored standard Morse taper No. 2 to take milling cutters, drills, &c. The milling bed has an area of approximately 7in. by 6in., and has four T slots for clamping the work. This bed is mounted on the saddle of the lathe in place of the top slide rest. It is cross-traversed by the ordinary cross feed screw. The longitudinal traverse is obtained in the usual way from the main feed screw and clutch situated behind the saddle apron. The drive of the attachment is obtained from the fly-wheel on to a countershaft attached to the underside of the chip tray. This shaft has a three-grooved pulley. A belt runs from this pulley over adjustable belt-tightening pulleys and horizontally on to a pulley on the top of the milling spindle.

Mr. Henry Milnes is exhibiting several lathes, among which there is one of 3¾in. centres that has been improved in several directions with the idea of facilitating the frequent adjustments or alterations which are such a feature of most amateur work. Thus the lock between the belt pulley and the mandrel, which is used when the back gear is not required, takes the form of a spring catch that drops into place of itself when released. The quadrant for the change wheels is clamped by a large nut with a permanent handle, and the tailstock is held by an excentric device. The centres have been increased in size to No. 2 Morse taper, and advantage is taken of the change to make the bore through the mandrel ¼in. in diameter. The balance weight, which is usually put on the fly-wheel to bring the treadle to the top of its stroke when released, is replaced by a strong spring fixed to the end of the crank pin and attached to the underside of the chip tray. The lathe is driven by a 1in. flat belt, and the maker claims that it will maintain its accuracy while withstanding the heaviest cuts which the belt will drive.

There are several distinct types of lathe on the stand of F. Patrick, Limited, Penraevon-place, Meanwood-road, Leeds, ranging from a little single-geared machine of 2in. centres up to a fully equipped screw-cutting and surfacing 4½in. back-geared lathe. The little single-geared machine has a compound slide rest somewhat similar in general idea to that of the smal Drummond lathe, and it will take 11in. between thl centres. Another of the machines on the Patrice stand is a single-geared 4½in. screw-cutting bench lathe, which will take 15in. between the centres.

A 3½in. lathe with a rather unusual arrangement of slide rest, for such a small size, is being shown by Messrs. Irwin and Jones, Limited, of 3, New London-street, London, E.C. 3. The bed has two sets of ways planed on it, one for the back centre and the other for the saddle. The saddle embraces the bed on the underside, and thus leaves the central ways quite free, so that the back centre can be brought right up to the face plate. The slide rest is fixed on the front of the saddle, while another table works on slides fixed to the saddle behind the bed. The two tables can be connected together by a tie bar and thus used for boring work. The mandrel is bored through ¼in. in diameter, and is fitted with a No. 2 Morse taper centre, while the back centre is of No. 1 taper. The distance between the centres is 14in.

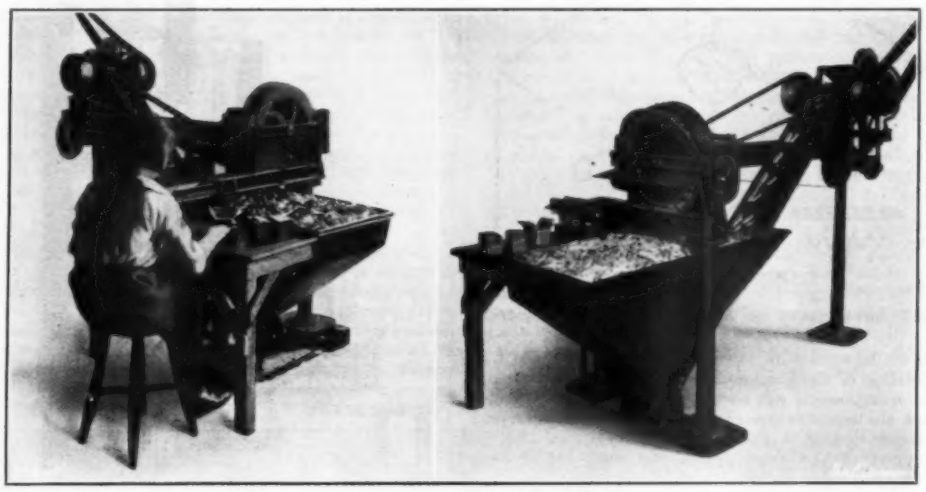
A handy little electric lighting set is being shown by Stuart Turner, Limited, of Henley-on-Thames, and is being used to light the stand. It has a 1 horse-power two-stroke engine with a cylinder 2½in. bore by 2½in. stroke, and drives a ½-kilowatt dynamo, direct, which generates at 25 volts. A semi-automatic type of control gear is arranged in a neat casing, and thirteen storage cells are provided to work in parallel with the dynamo.

A Firewood Boxing Machine.

THE illustrations which we give below represent an ingenious little machine which has been devised by M. Glover and Co., of Holbeck-lane, Leeds, for arranging small splints or sticks in a convenient manner for filling them into light paper boxes for use as fire lighters.

The splints, which are about 2½in. long and are made in one of Glover's chopping machines, are delivered into the hopper that forms a prominent feature in the illustrations. Running up the back of this hopper there is an elevator belt, provided with steps or flights, which raises the splints to the feeding mechanism seen at the back of the machine in the illustrations. The splints then slide down an inclined shoot on to another conveyor belt. This belt is driven at a considerable speed, and is bounded on either side by fixed guides fixed about 1½in. apart, with the result that the splints are carried back to the front of the machine endways, with sufficient force to be shot off the end of the belt into the partitions round the periphery of the slowly moving wheel mounted above the main hopper. If one of the splints happens to hit one of the partition plates instead of passing between them, it merely drops down into the hopper below and is carried up again by the elevator. The partitioned wheel is driven by worm gear and a belt working off the shaft at the back of the machine. Behind the wheel there is a flapping plate, operated by a three-faced cam, which shakes the splints down into the partitions. The wheel revolves in a clockwise direction, and delivers the splints into a trough below along which they are pushed by a plunger. This plunger is operated by a lever and a cam which is fixed on the end of the worm gear shaft. Towards the end of the trough there is an opening in the bottom, through which the splints drop into the boxes. The box is supported on a plunger in the raised position by a spring, and is left until it is filled with splints. A foot lever is then used to depress the plunger, and another box is put in its place.

The machine illustrated has, we understand, recently been shipped to France.



GLOVER'S FIREWOOD BOXING MACHINE

THE capacity of the South Manchuria Railway Company Electric Power House, Dairen, is, according to an article which appeared in a recent issue of the *Manchuria Daily News*, 4875 kilowatts. The total amount of energy generated during 1920 was 14,074,770 B.T.U., the revenue on which was 1,632,598 yen against an outlay of 977,918 yen. There were connected to the distribution mains 150,048 lamps contained in 21,778 households. In terms of 10-candle units, the number of lamps represented is 348,757, giving 6.9 lamps per household. The average candle-power of the lamps installed is, actually, 23.2.

Railway Matters.

THE Minister of Transport has recently confirmed the Totton Hythe and Fawley Light Railway Order, 1921, made by the Light Railway Commissioners authorising the construction of a light railway from Totton to Fawley in the County of Hampshire.

THE proposals of the Scottish railway companies as to their men's pay and conditions of service having been, as related in this column on December 9th, referred by the Central Wages Board to the National Wages Board, will come before the latter body on the 10th instant.

BEGINNING 1923, the Government of India will invite tenders annually for all the railway locomotives and stocks required during the ensuing twelve months. The average annual requirements will be 160 engines and 160 additional boilers during 1923 and 1924, and thereafter 400 engines and 400 additional boilers.

THE Ministry of Transport has authorised the Lee-on-the-Solent Railway being classed as a light railway under the Acts of 1896 and 1912. It is one of the subsidiary railways to be absorbed into the southern group, and is now worked by the London and South-Western Railway. There are benefits that a small railway enjoys if it be classed as a light railway.

THE Department of the Census has issued a summary of preliminary occupation statistics for the United States for 1920, which shows 3,066,305 persons in the United States as gainfully occupied in transportation industries, or 7.4 per cent. of the total persons gainfully occupied, of which 2,852,043 were males, or 8.6 per cent. of the males gainfully occupied. The number of females engaged in transportation was 214,262, or 2½ per cent. of the gainfully occupied females. The number of females occupied in the various transportation industries had increased by 106,596 in 1910.

TWO awards have been made by Mr. Carrigan, the independent chairman of the Irish railways arbitration board. One modified the eight hours' day, and this the men do not like. The other award related to wages and conditions, and this was more favourable to the men than was the first award. The companies announced that they would put the award into operation on Sunday last, and this intimation led to the men threatening to strike. The Dail Eireann got in touch with the companies, and the change was postponed until the 15th instant, which will allow time for efforts to adjust matters.

ONE of the last cases to be tried at the recent Manchester Assizes was one brought by a lady against the Lancashire and Yorkshire Railway Company for damages resulting from her falling between the platform and railway carriage when alighting at No. 13 platform, Victoria Station, Manchester. The line is on a considerable curve here, which makes an unusual gap of 8½in. The judge gave a verdict for the company on the ground that the plaintiff was a regular passenger by that particular train, and knew of the gap. It was daylight, and she ought to have looked. To this particular lady the gap was not a trap. He was not saying what it would have been to other people.

THE new president of the National Union of Railwaymen is Mr. J. Marchbank of the Caledonian Railway, Glasgow, the first Scotsman to fill that office since the presidents were drawn from railwaymen solely. He is the eldest son of a shepherd, and one of a family of five children whose father's total emolument was £30 a year and the free use of a moorland cottage. The *Railway Review*, to whom we are indebted for this information, adds "It is curious that the last three presidents of the National Union of Railwaymen have risen from gardener-boy, plough-boy and shepherd boy, each of them a natural philosopher, much given to literature and preferring a book and a nook to a crowd."

THE German State Railway has recently experimented with a new type of third-class sleeping compartment on the Berlin-Jena line. The new compartments do not contain beds, but have three sloping shelves placed one above the other, the lowest of which during the day is converted into an ordinary seat, the middle one into a back, while the upper one is used as a rack for parcels. The occupant of the upper shelf climbs into position by means of a folding ladder. The Administration intends to place these sleeping compartments on three lines, viz., Berlin-Cologne, Berlin-Munich, and Berlin-Konigsberg. In view of the low price of the "Liegekarten"—40 marks per person—a great demand for the accommodation thus provided is expected.

THE current issue of the *Great Western Railway Magazine* publishes the following statistics as to the number of signal-boxes levers, signals, &c., on that company's system at the end of the year 1921:—1645 signal-boxes, 594 ground frames, 21,600 signals, 9200 independent discs, 11,310 points, 3428 facing point locking-gear sets, 48,280 working levers, 657 level crossing gates operated from signal-boxes, 641 level-crossing gates protected by locking or signals, 433 weighted fouling bars, 186 detonator-laying machines, 2042 emergency detonator-placing machines, 570 electrically worked signals, 870 track circuits, 29,289 long-burning lamps, 10,850 telephones, 4460 portable accumulators. During 1921 71,000 accumulator recharges were made.

THE London and North-Western Company would appear to have at last settled on a definite policy for its signal and telegraph departments. Its signal department was established in 1873, and was, during Mr. F. W. Webb's *régime*, an adjunct to the Crewe works, first under Mr. C. Dick, and then under Mr. A. M. Thompson. When Mr. J. W. Fletcher retired from the position of telegraph superintendent the two departments were combined under Mr. Thompson. This ideal arrangement was, however, abandoned when Mr. Cortez Leigh was made the electrical engineer. The directors, not recognising that telegraphs and telephones were widely separated from electrical power for traction, lighting, &c., transferred the telegraph department to the electrical engineer. This has now been remedied by making the chief engineer, Mr. Trench, responsible for "the provision and maintenance of telephones, telegraphs, block instruments, track circuits, and any electrical appliances used in connection with signalling."

Notes and Memoranda.

SOME experiments carried out by the Building Research Board show that walls built with Fletton bricks on edge in cement 2¼in. thick resisted a much higher crushing load and horizontal pull than those built with the same bricks laid flat in lime mortar 4½in. thick. The full report on the tests may be obtained from H.M. Stationery Office, price 6d.

IN a report issued by the Department of Scientific and Industrial Research it is said that in some cases it may be found that concrete floors form an alternative to timber at a price slightly exceeding the latter. It should, however, be noted that they have obvious advantages in their capacity to resist fire and vermin, that they are not subject to dry rot, and that they help to tie the building together in a more efficient manner than does the ordinary floor.

A FLAME of extraordinarily high temperature, which has been employed in experiment by E. Hauser and E. Rie, is mentioned in the *Chemical Trades Journal*. It is produced by liquid fuel, which is led by a tube from a storage container to a special burner, where it is atomised and forced out into a horizontal cone by a stream of hydrogen or other suitable gas, and combustion is intensified by a mantle of oxygen enveloping the cone from the outer part of the burner. It is estimated that the temperature reached is at least 3000 deg. Cent.

IT is not suggested, in a report on fuel for motors transport, by the Fuel Research Board, that alcohol in any very large quantities can be produced from either the sugar mangold or the Jerusalem artichoke in this country, owing to the restricted area available for, and the high cost of, cultivation. On the other hand, however, such cultivation might be the means of reclaiming waste land, of adding to the food supplies of the country, and of providing alcohol and cellulose for peace industries, and solvents and raw materials for the manufacture of propulsive explosives in the event of war.

IN commenting on the recent report that a German chemist had succeeded in making synthetic gold from baser metals, the *Chemical Trade Journal* says:—"If, however, the improbable has happened, and the long-dreamed-of 'philosopher's stone' has materialised, its effects will be much more far-reaching than the old alchemists had imagined. The production of gold will be but a subsidiary matter compared with the concomitant greater control over sub-atomic forces, and the quantities of the world's real wealth and energy will be so enormously increased that the old standards of value would in any case have only an academic interest."

IN a report on the Alaskan mineral reserves, by Dr. A. Brooks, of the United States Geological Survey, it is stated that there are good prospects for the silver and lead mining industries in the Kantishna Valley. About fifty prospectors are at work, and a good deal of placer mining is already being carried out. Two companies have been organised for hydraulic mining, but will not begin work for some months. The transport facilities in this district are not good, and if they could be improved and developed an immense impetus would be given to mining. In addition to its large undeveloped resources in gold, Dr. Brooks refers to the country's wealth in tin, tungsten, platinum, sulphur, antimony, mercury, gypsum, and graphite.

IN an article appearing in the *Electrician* on "Electric Lifting Magnets: Their Construction and Application," Mr. F. A. Hooper asks:—"What happens if the current fails? The answer is, of course, that unless some sort of safety device is installed, the load must drop." With a modern electrical installation, however, the possibilities of failure are not very great, and if the magnet is wired back to the main supply and not run off an auxiliary circuit the occasions on which the main breaker comes out are very few and far between, and certainly not more frequent than a sling slipping or a chain breaking. Further, men do not usually walk about beneath a crane load, whether it is slung by chains or magnetically. It is believed that there is no case on record of a fatal accident or, in fact, of any accident being caused by a lifting magnet dropping its load.

THE production of pig iron in December amounted to 275,000 tons, a figure slightly in excess of the production in November, when it was 271,800 tons. The furnaces in blast at the end of December numbered 77, compared with 85 at the end of November, 15 furnaces having gone out of blast during the month and 7 re-lit. The production of pig iron for the year amounted to 2,611,400 tons compared with 8,007,900 tons in 1920. This figure is lower than in any year since 1850, when the production of pig iron amounted to 2,249,000 tons. Of the production of pig iron in December, 92,400 tons were hematite, 81,500 tons were basic, 13,800 tons were forge, and 78,600 tons were foundry. The production of steel ingots and castings in December amounted to 381,000 tons, or 62,000 less than November. The total production of steel for the year amounted to 3,624,800 tons compared with 9,056,800 in 1920.

DISCUSSING a paper on "Liquid Fuel," read before the Institute of Marine Engineers by Mr. J. H. Anderson, Mr. N. A. Anfilogoff said that he would like to give the following practical hints:—Unless the combustion space is sufficient one cannot obtain complete combustion of liquid fuel. When the boiler furnace has been designed with an idea of burning coal, and grate area only was taken into consideration, it can be taken that the combustion space would be insufficient for burning liquid fuel weight for weight. In order to get the oil into the furnace in a very finely divided state one has to employ the best possible means. Unless the oil is properly heated, filtered, and atomised, a condition will arise in which little chunks of oil will be thrown into the furnace and deposited in the corrugations or even in the back combustion chamber, where they will slowly collect and get converted into porous masses of carbon which will burn away very slowly. Any oil imprisoned in the masses will probably contain a certain percentage of sulphur. This sulphur may get converted into injurious compounds, which, as gases, would travel through the pores of the mass and become deposited or condensed in the coolest part of that mass, which would obviously be the boiler plate.

Miscellanea.

RICH deposits of china clay have been discovered in the foothills of Dartmoor, between Bovey Tracey and Lustleigh.

THE output of copper ore at the Mount Lyell Mines, West Coast of Tasmania, has been increased to 18,000 tons monthly.

IT is said that there are 100,000 tons of zinc and lead ores, already mined, waiting for purchase in the Shuikonshan province of Hunan, China.

THE three crude oil depôts which are being constructed near the port of Cueto, in Morocco, for vessels using liquid fuel are expected to be completed in April or May next. Each depôt will hold 8000 tons.

THE New Jersey Tunnel Commission has invited tenders which are to be opened on February 7th for contracts Nos. 3 and 4 for the construction of two cast iron tunnels under the Hudson River from New York City to Jersey City.

WE have received from the *Blackpool Times* a copy of its issue of January 6th, which is printed throughout by the photo-litho offset process, and is claimed to be the first newspaper so printed in this country. The result is admirable, the excellence of the reproduction of photographs on ordinary "news-sheet" being quite remarkable.

IT is proposed by the Waterloo Chemical Works, Sydney, to establish works at Hobart, Tasmania, for the electrolytic manufacture of pigments from scrap iron. Advantage will be taken of the cheap hydro-electric power, 500 horse-power being ultimately required. The initial output will be 10 tons weekly, but large works are contemplated.

AS a result of the experience obtained by keeping the library open every evening and Saturday afternoons during the last few weeks, the Council of the Institution of Electrical Engineers has decided that in future the library will be kept open until 9.30 p.m. on the nights on which are held the ordinary meetings of the Institution, the informal meetings, and meetings of the Wireless and Students' Sections.

ALTHOUGH the United States has only 6 per cent. of the world's population and 7 per cent. of the world's land, it yet produces, according to Judge Gary, 20 per cent. of the world gold supply, 25 per cent. of the wheat, 40 per cent. of the steel and iron, 40 per cent. of the lead, 40 per cent. of the silver, 50 per cent. of the zinc, 52 per cent. of the coal, 60 per cent. of the aluminium, 60 per cent. of the copper, 60 per cent. of the cotton, 66 per cent. of the oil, 75 per cent. of the corn, and 85 per cent. of the motor cars.

POWER began to be generated from the Chippawa-Queenston power canal on the Canadian side of the river at Niagara Falls on December 28th. The unit to be put in operation is of 55,000 horse-power, and it was expected to be connected to the load about a week later when a second turbine of equal capacity would, it was anticipated, be ready. The power plant below the cliff at Queenston will eventually have a capacity of probably 650,000 horse-power. Five units will be of 55,000 horse-power capacity and four additional, which are yet in the projection stage, may generate 75,000 horse-power each.

THE value of British exports to the Argentine according to the Board of Trade statistics is as follows:—1913, £22,640,943; 1919, £21,217,214; and 1920, £42,839,819. Even the more optimistic scarcely expected to see such a large increase in 1920 compared with the last year before the war. That this trade was continued during the first quarter of 1921 is shown by the value of exports from the United Kingdom during that period, which amounted to £10,232,605. It is only to be expected, however, that in view of the depression in trade and the coal strike in the United Kingdom that the returns for the remainder of 1921 will show a diminution.

A POSSIBLE source of alcohol in Australia is its synthetic production, but it would be possible only if very cheap power were available. The question of electrical power generation, using for the purpose the enormous deposits of brown coal in the Commonwealth, is now engaging the attention of the Victorian Government. Given cheap electricity, the manufacture of calcium carbide and the production of alcohol from it by catalytic processes are economically practicable. Moreover, cheap electricity makes it possible to produce cheap artificial fertilisers, the provision of which would materially assist the growing of suitable crops for the production of power alcohol by the usual fermentation processes.

WORK has been started at the plant of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., on what is described as the largest single order for electrical transformers ever placed, according to announcement made by officials of that company. The order which was placed by the Diado Dendrioku K.K. (The Daido Electric Power Company of Japan), is for thirty-four transformers averaging 9400 k.V.A. each, a total of 316,400 k.V.A. The transformers will be single-phase, 60-cycle, oil-insulated and water-cooled, and will have a high voltage of 154,000 volts, which is the highest voltage in commercial use at this time. When installed, they will weigh 50 tons each. They are for use in a super-power system in the industrial district round Tokyo.

ALTHOUGH up to the present very little has been done in China to produce nickel on a systematic basis, there is a strong probability that in the future this metal will be produced on quite a large scale. According to the *Chamber of Commerce Journal*, it has been found so far in three regions. In Yunnan nickel ores consisting of glance, pyrites, and kupfer-nickel occurring in the gneiss, slate, and quartz rocks of south-eastern Yunnan have been seen and sent to London for assay purposes, but no workings for this metal exist in the region. Certain galenas assayed from the Tungchwan region have been found to contain a small percentage of nickel. Associated with cobalt, the metal appears to exist in ores sent in for examination from the Red River district, to the west of Kochiu, but in none of these regions is any mining gong on at the present time. Near Weining, in North-West Kweichow, ores containing nickel in conjunction with bismuth have been examined, and nickel has also been found in Shensi.

NEW OUTFALL SEWER FOR MANCHESTER

MR. J. B. L. MEEK, M. INST. C.E., MANCHESTER, ENGINEER

(*For description see page 38*)

FIG. 2—JUNCTION CHAMBER OF OLD AND NEW SEWERS

FIG. 3—INTERIOR VIEW OF 15FT. 3IN. SEWER

FIG. 4—CANAL CROSSING

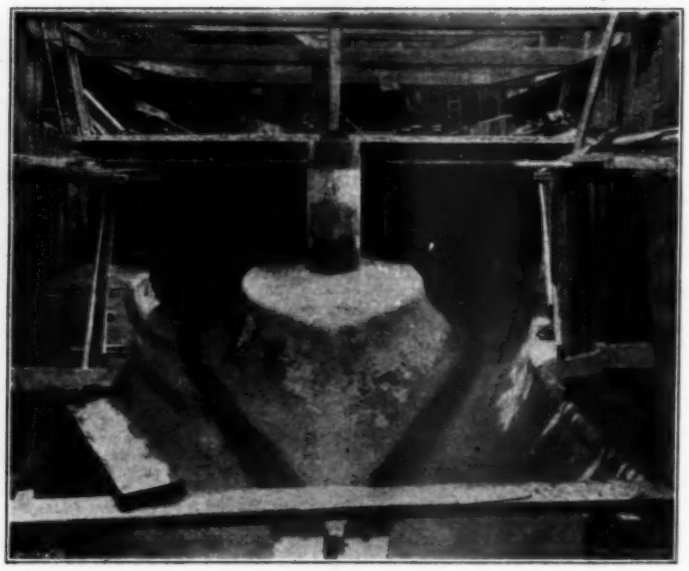


FIG. 5—CANAL CROSSING

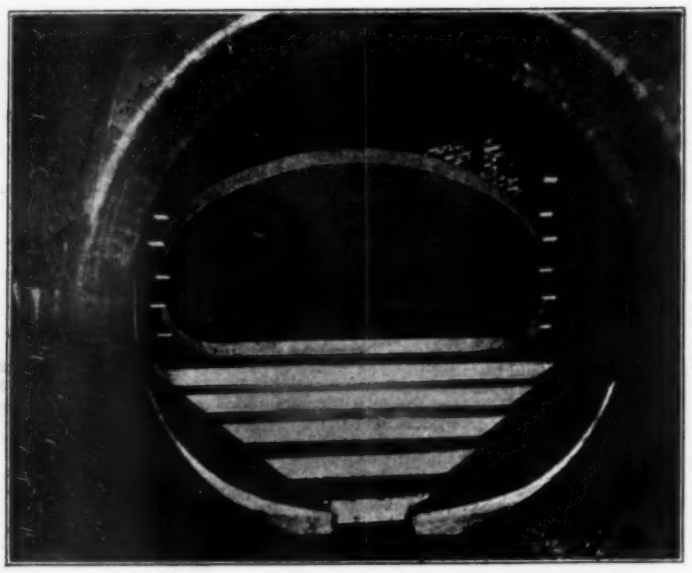


FIG. 6—STORM WATER OVERFLOW CHAMBER, SHOWING CARRIER

FIG. 7—NEW SEWER CROSSING OLD STORM OVERFLOW SEWER

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Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

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. *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

. *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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DEATHS.

On the 9th January, at Nova Scotia House, Ipswich, CHARLES FOOTE GOWER, late M. Inst. C.E., aged 85.

On the 9th January, at 27, Bruton-street, W., suddenly, after a long illness, Sir ARTHUR LUCAS, aged seventy-six.

THE ENGINEER.

JANUARY 13, 1922.

The General Knowledge Test.

ACCORDING to the recent report, of a Committee appointed by the Ministry of Education, many large firms have had to confess their surprise and disappointment at finding the standard of English composition very low among their general office staff and the applicants for appointments thereon. It will be recalled that, at the meeting of the British Association in Edinburgh, the newly formed section of Psychology devoted its first meeting to a discussion upon "Vocational Tests and Vocational Training," and Sir William Beveridge, director of the London School of Economics, rather severely criticised employers for their alleged lack of method in their choice of persons for different occupations. There were few things, he said, which employers handled more inefficiently than the selection of their employees. It will also be remembered that the President of the Economics Section, Mr. W. L. Hichens, strongly dissented from this view, and maintained that employers exercised an extraordinary amount of care in choosing workers, both for higher and lower positions. Doubtless, in so far as Mr. Hichens was speaking for the better class of enlightened and enterprising employers, he was perfectly right; but, although all employers without exception should naturally, in their own interests, be most careful in the selection of employees, the main criticism directed against their present methods by educationists, and still more by the new profession of industrial psychologists, is that these present methods are highly unscientific and unstandardised. It is to be expected that the psychologists will be prone to emphasise the importance of their particular science in this matter, and if psychology can really substantiate the high claims made on its behalf and really discover what are the true aptitudes and capabilities of young people and indicate what work is best suited for them, then it would indeed be difficult to exaggerate its importance. But, in the enthusiasm which accompanies the exploration of a comparatively new sphere, there is risk of exaggeration, and in particular there is a risk that other factors in a complex problem may be overlooked or insufficiently considered. Even science has its limitations, and psychological science is no exception.

There is not only the difficulty of finding suitable applicants, but also the complementary difficulty of finding suitable work, and this latter difficulty in view of increasing specialisation, or specialism and the minute subdividing of work into its most simple and monotonous form, is rapidly increasing. In other words, education and industry would seem to be taking opposite paths and becoming more and more incompatible, instead of merging together into one great correlated entity. Increased and better education presumably implies more highly trained and developed faculties, enlarged hopes and wider ambitions; increased "specialism," on the other hand, presumably implies more finely subdivided and extremely simplified work, and therefore a rapidly diminishing scope for faculty or ambition of any sort. This is surely a real and serious difficulty which will have to be met, and it may play an important part among the underlying causes of industrial unrest. It is too far-reaching to be discussed here, but it may perhaps be pointed out that the attempt to mitigate the evil somewhat by means of plurality of tasks, or giving a man more than one kind of operation to perform, does not appear to have been very successful, at all events in America, according to the Hoxie report on scientific management. Whatever grounds the psychologists may have for criticising the employers, it appears, in the light of the report of the Committee on the standard reached in English composition by the majority of those leaving school, already referred to, that the educationists have little cause for criticism, and should rather strive to better their own methods. The chief weakness seems to be in trying to compass too much, taking up too many subjects, instead of taking fewer and mastering them thoroughly. The teaching of English, which the Committee rightly regards as the first essential and the best and surest foundation for further study and training, is truly a case in point. Neither employers nor psychologists can do very much unless the educationists lay a firm and true foundation. They, of course, realise this truth as well as or better than anyone else; the great difficulty here, as elsewhere, is to put guiding principles into practice. After all, the ability of a man to express himself and set down his ideas in good English is, together with the intrinsic value of the ideas themselves, the true measure of his education. If this is low, and the disappointment of the employers correspondingly great, in applicants of the rank-and-file grade in shop or office, it must be still lower, relatively, and the disappointment proportionately greater, in the case of applicants for positions of executive and management grade. Moreover, psychological tests, as at present devised, do not appear to be of much value in testing a man's executive ability beforehand. At least, that has been the experience of one large employer of labour in America, Mr. Thomas Edison, who does not appear to have a very high opinion of either the psychologists or the educationists. His extraordinary *questionnaire*, consisting of one hundred and fifty questions in "general knowledge," has doubtless now become famous, and although it has been the subject of much criticism in America, its author claims that it has been justified by results. Those candidates who answer correctly a certain percentage or more of the questions are classed as "A" men, and are at once taken into the factory to be trained for executive positions. Edison says that these men all prove to be first-class men for executive positions. Sometimes, when he has been unable to get a sufficient number of "A" men, he has been tempted to try "B" men for such positions, and he has been invariably disappointed with the result. Actually, the whole thing reduces itself to an examination in general knowledge, that is to say, a memory test. Edison emphatically declares in favour of a good memory as being the first essential. He does not, of course, mean that it is the only one, but if a man exhibit a bad memory then he lacks the first qualification, and nothing else matters. Granted that memory is fundamentally important, it is clear that many other qualifications are left over to be investigated during the subsequent training in the factory. The general knowledge test is merely a preliminary weeding out; nothing more than an entrance examination. Edison himself admits that most of the questions are very easy and elementary, as, indeed, they are, and that if a man is unable to answer at least fifty per cent. correctly he must be an imbecile. Ninety per cent. correct is required in an "A" man. The real value of the *questionnaire* is not so much in providing an original method of gauging executive ability as in discovering what appears to be a weak point in American education methods similar to that discovered by the Committee on English Studies in this country, although hasty general conclusions are not to be drawn in either case. According to Edison, the

results of his *questionnaire* are deplorable, and the crop of "howlers" is a truly magnificent one. Out of 718 candidates only 57 could correctly answer 70 per cent. of the questions, and only 32 reached the 90 per cent. grade. He is of opinion that the American colleges have failed miserably, and that the schools below them are still worse.

So far as we in this country are concerned, our educationists are no doubt working hard to evolve a thoroughly good system, not only to make the man a better workman, but also to make the workman a better man; and they realise well enough that the elementary schools must lay the foundations well and truly; otherwise the efforts of both psychologists and employers will be seriously handicapped. Furthermore, they are fully aware—and we are all probably agreed on this—that the real aims of elementary education are primarily to instil a love of what is true and right as well as a love of knowledge. Employers want something more than mere cleverness and intellect, especially in the management and executive grade: they want character and integrity; things difficult to define and difficult to discover by psychological tests, however scientific.

Accidents to Platelayers.

IN working out, recently, some percentages as to the number of accidents to railway servants, we were surprised to find that one-third of the casualties to permanent way men prove fatal—the actual figures for 1920 were 105 fatal and 205 non-fatal, a proportion of 33.9 per cent. fatal. We also found that of the 80 accidents to men walking or standing on the line on duty elsewhere than at stations 53.7 per cent. were fatal. Since these figures came home to us there has been issued by the Ministry of Transport the report made by Mr. Main, the Assistant Inspecting Officer of the Railway Department, on the disaster that overtook a gang of platelayers near Stapleton-road, Bristol, on September 26th, which, in part, explains why there is such an alarming proportion of fatalities in the accidents to permanent way men. The gang in question consisted of eight men who were engaged in trimming ballast on the line from Avonmouth at a point about 620 yards north-west of Stapleton-road station. This line is parallel with the line to South Wales on which, at the time of the accident, a goods train with an assistant engine behind, was travelling. The standard rules of all the railway companies order that "when men are working singly or in gangs on or near lines in use for traffic, the foreman, ganger or other man in charge for the time being, must, in all cases where danger is likely to arise, appoint one or more persons as may be necessary, expressly to maintain a good look-out, and to give warning of any train approaching, and he must satisfy himself that the look-out man appointed is properly equipped, is stationed in a suitable position, and is wearing a distinctive badge." This was certainly a case where "danger is likely to arise," but although he had a duly qualified man in his gang, the ganger appointed no look-out man; and "seemingly, entire reliance was placed upon hearing the approach of trains—a common practice among platelayers." But owing to the passing goods train and the scraping of their own shovels, the men did not hear the approach of a passenger train from Avonmouth. Just at the moment one man happened to lift himself to straighten his back and saw the train. He had just time to jump clear, but not to warn the others, and the remaining seven were run down, five being killed outright and two injured, one of whom subsequently died.

Obviously the responsibility for the disaster lay with the ganger, who was one of the men killed. In this connection we are informed by Mr. Main that sixty-one inquiries were held by officers of the Ministry into cases where men had been struck whilst working on the permanent way, and that in twenty-one instances it was considered that a look-out man should have been in attendance. There is thus raised the question why, seeing that the rule we have quoted is so emphatic, gangers do not provide protection, and it will be pertinent to also ask why the companies do not see that the rule is obeyed. The answer to the first question is, in part, given in the words already quoted—the men rely upon hearing an approaching train. Before we come to the supplementary question we would further observe that it may possibly be suggested that the gangers may be afraid to incur the expense of taking a man from their gangs for this purpose. Such an idea, we are satisfied, may be dismissed. The rule has been laid down by the companies themselves, with the approval of representative maintenance-of-way engineers, and is intended to be obeyed. There is, however, just a fear—and here we reach our further point—that the engineers do not exercise sufficient care to see that this and other rules are obeyed. We have had some personal experience of the perfunctory way in which men in the permanent way are taught the rules. What, as Mr. Main says, is wanted is some system of instruction and periodical examination. The gangs should be visited from time to time, preferably unexpectedly, by someone who should ask each member of the gang questions pertinent to his own safety and the safety of his mates. It were better, too, if this were done by a man drawn from their own ranks who knows what the work is, what are the dangers and what the objections in the men's minds against doing what they have been told. Such men may be rare, but they do exist, and the engineers could lay their hands on them were it necessary. One advantage of such visits would be that it would be brought home to the men that they were the principal sufferers in the event of an accident, and that nearly every casualty that occurs is the result of the want of care on the part of the man himself or through the carelessness of one of his fellows.

The indifference of men to danger in which they live is proverbial, and it is necessary to force them to exercise those precautions which are designed for their proper safety. Mr. Main said that the remaining forty cases inquired into, where men were struck when working on the line, "clearly showed that the accidents were due to want of ordinary caution." The companies have done their share by rule and precept and by providing means of safety; the men, too, have a responsibility in that they should obey the rules and make use of the means. That these rules and means have had good results may be seen by comparing the figures of to-day with those of about twenty years ago. In 1901 the accidents to permanent way men which proved fatal were 41.5 per cent., and in 1902 they were 44.1 per cent.

Standardised Bricks and Coal.

THE paper read last Friday evening before a joint meeting of the Institution of Mechanical Engineers and the Society of Chemical Industry by Mr. G. H. Gill, the chief engineer to the South Metropolitan Gas Company, nominally dealt with the co-operation of the engineer and chemist in the control of plants and processes. In reality it amounted very largely, if not wholly, to a scientifically formulated grumble against coalowners, brick makers and retort manufacturers for supplying coal, bricks and retorts which varied to a disconcerting amount in quality or size. As to how the co-operation of engineers and chemists was to improve matters in these respects Mr. Gill was, very wisely perhaps, somewhat vague. It may be admitted that by the more careful regulation of the manufacturing processes, a work in which the chemist could play an important part, refractory bricks and retorts might be—in fact, certainly could be—improved in several ways important to the user. By the control of the ingredients used in brickmaking and of the mixing, drying and burning processes it seems established that it is possible to produce bricks of a high degree of uniformity as regards size. That there is need for improvement in this respect most engineers will agree, for in setting boilers or building furnaces as much as ten per cent. of the workmen's time may easily be wasted merely in selecting the bricks for each course so as to avoid thick joints or unevenness in the height of the work. In this connection it is satisfactory to learn that a Committee of the British Engineering Standards Association, with Professor Hinchley as chairman, is now considering the standardisation of refractory bricks. Users themselves are, however, not entirely free from blame. They have, we understand, in some cases, caused such a cutting of prices that makers have had no margin of profits with which to effect improvements. We recall a case which occurred some years ago, when certain retorts were being imported at a high price from the Continent. A well-known firm in this country then offered to produce retorts of equal quality if its price might be raised by ten per cent. The offer was not accepted, and a useful advance was hindered in consequence. It is to be regretted that some of the fire-brick makers did not take part in the discussion, as their views would have been valuable.

Variation in the quality of coal is also a subject of great moment to engineers, as all will admit, but in this matter Mr. Gill and those who grumbled with him—and nearly every speaker in the discussion did—seemed to us to have a far less sound cause for complaint than in connection with the sizes of bricks. The sizing of coal and the quantity of dirt accompanying it are items affecting the quality which the coal producer can undoubtedly control to a considerable extent, even though it be beyond his power to prevent variations which, according to Mr. Gill, are coincident with local football fixtures! But coal is not a manufactured material. We cannot govern its calorific value or the percentage of its volatile matter, fixed carbon, or ash. Considerable variations in these qualities occur even in coal derived from the same seam, and we think it would be unreasonable, even if it were possible, to ask the coal producer to supply to specifications drawn on the lines of those to which a steel maker, for example, has to work. The only possible way in which to secure uniformity in the quality of coal is by a process of mixing. We doubt whether such a process could be satisfactorily carried out except at great cost. Co-operation between different mines would almost certainly be necessary, output would be hampered, and in all probability the actual mixing process would, while improving the uniformity of the coal, produce a mixture of considerably lower value, mechanically and chemically, than the average of the unmixed coals. Whether uniformity of composition would counterbalance these disadvantages is an interesting subject for discussion.

LLOYD'S REGISTER SHIPBUILDING RETURNS.

FROM Lloyd's Register shipbuilding returns for the quarter ended December 31st, 1921, which have just been issued, it appears that the merchant tonnage returned as under construction in the United Kingdom at the end of December last, amounted to 2,640,319 tons which represents a reduction of about 643 000 tons as compared with the total at the end of the previous quarter. Under the present conditions even these reduced figures cannot be regarded as a true index of the activity of the shipbuilding industry in the near future. In order to enable a correct comparison to be made between the present figures respecting tonnage under construction and those for normal times, two factors must be taken into consideration, viz., that a large number of vessels (totalling over 720,000 tons) is included in the present totals although all work on them has now been suspended; and also that there is a certain number of vessels the completion of which has been postponed owing to abnormal causes and which, in the ordinary way, would have been off the builders' hands by now and would therefore not have appeared in the present totals.

As compared with the figures for the quarter ended September 30th, 1921, there was a considerable increase, viz., 159,000 tons, in the tonnage launched during the past quarter, and for the first time since September, 1920, there was also a slight increase in the tonnage commenced during the quarter. The total merchant tonnage being built abroad was 1,816,774 tons, but that total included about 400,000 tons upon which work has been suspended, leaving about 1,417,000 tons actually under construction. The country in which the largest amount of work is suspended is Italy, where tonnage amounts to over 50 per cent. of the total tonnage recorded as under construction. The tonnage being built abroad was about 443,000 tons lower than the total being built at the end of September, 1921. The decrease affects most countries, but specially the United States of America, in which country the tonnage now under construction is less than 5.2 per cent. of the total being built there in March, 1919. The leading countries abroad are: Italy, with 393,832 tons; France, 352,635 tons; Holland, 313,879; tons; United States, 216,428 tons; and Japan, 144,912 tons.

The returns show that there are at the present time 121 steamers and motor-vessels, each of over 1,000 tons, with a total tonnage of 793,193 tons, under construction in the world for the carriage of oil in bulk. Of the total 82 of 535,019 tons are under construction in the United Kingdom. The tonnage of vessels now being built which are to be fitted with internal combustion engines, amounts to 368,494 tons. Of the total tonnage, 4,457,093 gross tons, under construction in the world—which total excludes vessels, the construction of which has not actually been commenced, and also all vessels of less than 100 tons—2,980,937 tons are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register book.

IN the course of some notes, contributed to the American Society of Civil Engineers, on the identification and restoration of the corners of cadastral surveys, Mr. H. R. Farnsworth says that on the treeless prairies of the Central Western States, where original corners were generally constructed of wooden posts or small stakes with pits and mounds, he has identified and reconstructed hundreds of such monuments long obliterated and considered lost, by the ordinarily simple, but sometimes very expert, process of removing the top sod or soil with a sharpened spade and revealing the distinct outlines of the original pit beneath, in the exact form as left by the builder years before. The original pit has gradually filled with blowings and wash of a distinctly different nature from the homogeneous soil on all its sides. During many years of experience in this work the writer has recovered indisputable outlines of such original pits under all conditions and kinds of soil—in roadways, on steep slopes, and on lands subject to overflow—and he has no hesitation in stating that when once dug, if any part of the original sides of the pit still remains, the fill in the centre can be identified with certainty by this method.

Obituary.

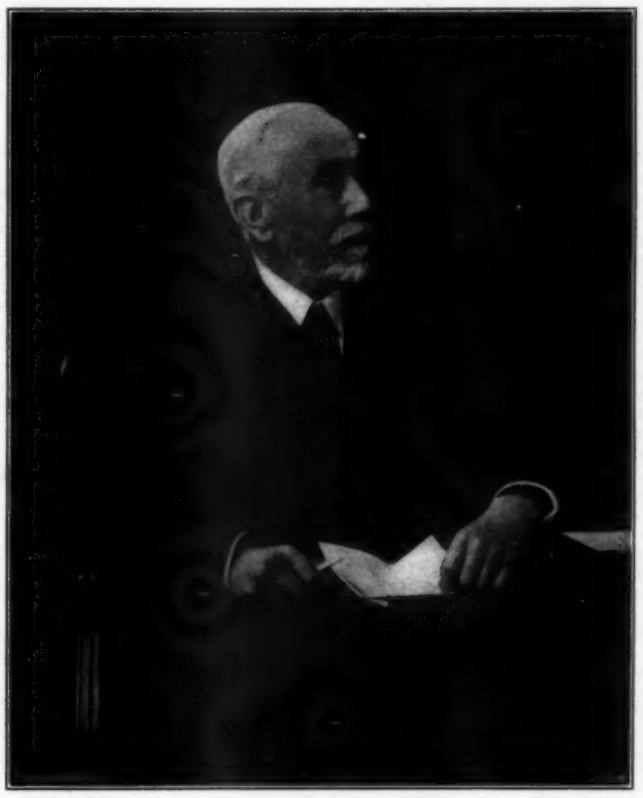
SIR WILLIAM MATTHEWS.

A DISTINGUISHED member of the engineering profession has been lost by the death of Sir William Matthews, which took place at his house in Hampstead on Sunday evening last. Sir William had been in indifferent health for some time, and about eighteen months ago he, on the advice of his doctor, gave up active work.

William Matthews was the elder son of the late Mr. John Matthews, his younger brother being Sir Thomas Matthews, until lately chief engineer to the Trinity House. He was born at Penzance, of which his father was town surveyor, on March 8th, 1844, and he was therefore approaching the completion of his seventy-eighth year. After receiving his early education privately in Cornwall, he entered his father's office at the age of fifteen and remained there for a couple of years. He then spent a year—1861–2—in the drawing office of Messrs. Sandys, Vivian and Co., engineers, of Copper House, Hayle, near St. Ives, in Cornwall, a firm which, at that time, had a considerable reputation as makers of heavy pumping and mining machinery. A period of slackness in the firm's business occurring some twelve months after he entered its service, the young man returned to Penzance and again entered his father's office, where he was engaged on general engineering work for two years or more, gaining useful experience, for his father, in addition to his municipal work, was also engaged in other constructive work in various parts of West Cornwall. In the year 1864, that is to say, when the subject of this memoir was twenty years of age, the Corporation of Penzance called in Mr. (afterwards Sir) John Coode, of Westminster, in connection with the proposal to build a wet dock in the tidal harbour of the port. For this purpose it was necessary to make a somewhat extensive engineering survey of the harbour, the foreshores adjoining it, and the sea bed in its vicinity, and by, for him, an exceedingly fortunate chance, the work was entrusted to young Matthews. Exactly how long the operations took we do not know; apparently not very long, but there is no doubt whatever that they were carried out exceedingly well; so well, in fact, that Mr. Coode offered to take him as a pupil in his London office, an offer which, it is needless to say, was immediately accepted. The term of pupilage—three years—occupied the period 1864–67, and thereafter Mr. Matthews remained with Sir John for the succeeding twenty-two years as chief assistant, subsequently, in 1892, becoming a partner at the same time as Sir John's son, Mr. J. C. Coode, entered the firm. When first he came to London the young man was employed in making marine and other surveys, and later as assistant engineer at the Port Erin breakwater works. Subsequently for some six years he was chief assistant engineer in carrying out extensive harbour, river and drainage works at Worthing, Douglas, North Level Sluice and at Thornby, near Peterborough, his experience at the end of that period—though he was but thirty-two years of age—being considered to be of a sufficiently high standard to warrant his transference from the class of Associate Member to that of full Member of the Institution of Civil Engineers. It is of interest to note that the transfer proposal form was signed, amongst others, by Sir John Hawkshaw, Sir Charles Hutton Gregory, Sir James N. Douglass and Sir John Wolfe Barry, and that it was countersigned, on the transfer being completed, by George Robert Stephenson, who was President of the Institution in that year—1876.

To refer in detail to all, or even to the more important of the engineering work with which Sir William was connected during his long and successful professional career would be impossible in an article of this kind. Moreover, it is a difficult task to say exactly how much of any particular work which was carried out by a firm, all the members of which have been engineers of high repute, is due to any one member of it. Hence it must suffice to refer to a certain number of the engineering triumphs which were achieved during his long connection with the firm, in all of which he took a share, and in some of which he not only played a leading, but an exclusive, part. It has been said of him, indeed, that monuments to his skill exist in ports and harbours throughout the world. Before Mr. Matthews joined him, Sir John Coode was, of course, well known in connection with harbour, dock, river and estuary works both at home and abroad, and during his frequent absences on colonial tours, one of which lasted as long as ten months, the business at home was managed by his chief assistant, Mr. Matthews, who thus had unusual opportunities of obtaining wide and varied experience in the exercise of his profession. Later, Mr. Matthews was himself to make many similar journeys, with far-reaching results. Such journeys took him, for example, to Ceylon, Hong Kong, Singapore, Penang, the Malay States, the Cape, Cyprus, Gibraltar, and numerous other parts of the world, at all of which important works were carried out.

The firm, which became Coode, Son, and Matthews, when he was made partner in 1892, has for many years occupied the position of consulting engineers for harbours and docks to the Crown Agents for the Colonies, and Sir William was actually senior consulting engineer to that Department, in order of date, having been connected with it as advisor on professional matters for nearly forty years. The firm was also called in by the Admiralty from time to time for advice concerning works connected with naval bases. In that capacity it reported on the extension works at Keyham Dockyard, and also as to the sheltering breakwaters at Malta, which were required for the protection of the Grand Harbour during the prevalence of what are locally known as "gregales," or strong north-east winds. The works which were proposed were carried out by the Director of Works Department.



SIR WILLIAM MATTHEWS

The outstanding work for the Admiralty with which the firm was connected was, however, the naval harbour at Dover, which was commenced in 1896 and completed in 1909. With that important undertaking, which was in every way successful, Sir William's name is specially identified. By it an area of no less than 690 acres was enclosed, 610 being for naval and 80 for commercial purposes. It was carried out under the Naval Works Act, Sir Henry Pilkington and subsequently Sir Edward Raban being Engineers in Chief, Messrs. Coode, Son, and Matthews chief engineers, and Messrs. S. Pearson and Son contractors. The sheltering piers of the enclosure are of great extent, the prolongation of the original Admiralty Pier reaching to as much as 2000ft., and the structure being nearly 100ft. in height from foundation to parapet, 60ft. of which is below low water.

Another vast maritime work in which Sir William was particularly interested was the harbour at Colombo, which is one of the largest artificial harbours that has hitherto been constructed. Sir William also carried on the work in connection with the harbour and docks at Capetown, which had been commenced by Sir John Coode upwards of fifty years ago and were afterwards extended from time to time to meet trade expansion. Although Sir William was the last person in the world to advertise himself or to seek for praise for what he had done, we have reason to know that he was particularly pleased with the work which was carried out to his designs in Table Bay. He was an expert in the construction of breakwaters destined to withstand heavy seas, and he reduced to a fine art the building of such structures by the aid of concrete blocks of large dimensions. For such work large Titan cranes are employed, and for some years the late Mr. Walter Pitt, of Stothert and Pitt, of Bath, worked very closely in connection with him. Other examples of the same class of work with which Sir William was connected was the re-building of the North Pier entrance to the Tyne, which was carried out in collaboration with Sir John Wolfe Barry, and the new pier at Folkestone. Still another, a work which is not even yet completed, though it has been under way for many years now, is the Harbour of Refuge at Peterhead, which has a low-water area of 285 acres. The work is now being carried out by the Admiralty, convict labour being extensively employed.

In all these cases particularly severe wave action had to be contended with. At Dover, waves with a height of from 15ft. to 18ft. are experienced. At the mouth of the Tyne, measurements of from 35ft. to 40ft. have been noted, while at Peterhead there are records of waves closely approximating to 40ft. in height from crest to trough. There, during a severe storm in 1898, blocks weighing upwards of 41 tons were displaced at a level of nearly 37ft. below low water of spring tides, the rise of such tides being 11ft. A section of the breakwater weighing 3300 tons was also slewed bodily 2in. without the blockwork being dislocated. Calculations showed that to effect such movement a wave force of fully 2 tons per square foot must have been exerted simultaneously over the area in question. At Colombo, during the carrying out of the south-west breakwater, a length of wall 28ft. in width, founded at 20ft. below low water, the rise of tide being 2ft., was slewed inward by sea action to the extent of 15in. at the outer end, the portion of the work affected being 150ft. in length. The blocks had subsequently to be lifted and re-set on true lines. It was with such colossal forces that Sir William contended, and contended successfully.

Another extraordinarily interesting undertaking which was completed by the firm under Sir William's special direction in 1904 was the sea embankment or barrier in the estuary of the Duddon at Hodbarrow, in Cumberland. By it 170 acres of foreshore were shut out from the sea so that an exceptionally rich and abundant deposit of hematite iron ore, which lay at a depth of 300ft. below the sea, might be won. The work, which was of novel construction, had to be water-tight and of such a character as to resist wave action during storms from the south-west, which are in that neighbourhood sometimes of an especially severe character, wind speeds of 90 miles an hour having been experienced. The closing of the barrier in order to shut out the tide is described as having been an interesting but at the same time an anxious proceeding.

Among the most important undertakings on which Sir William was engaged during the later years of his life were the series of works at Singapore, which consist of a wet dock 24½ acres in area having a depth of 30ft. at low water of ordinary spring tides; and a graving dock 846ft. in length on the floor, having an entrance 100ft. in width at coping level and a depth over the sill of 34ft. at H.W.S.T. This is probably the largest dock of its kind in the East. In addition to the foregoing, which have been completed, there is the reconstruction of the main wharf now in progress, having a length of about 4400ft., with 33ft. depth alongside at low water. In connection with these works Sir William visited Singapore at the end of 1901 and again in 1905. On the last occasion one of the primary objects of his journey was to advise the Straits Settlements Government with regard to the taking over of the works and property of the Tanjong Pagar Dock Company, a matter on which he gave evidence at an arbitration held at Singapore.

Among other bodies for which Sir William's firm acted as advisors were the Board of Trade, the India Office, the conservancies of the Mersey and the Humber, and the Tyne Commissioners. Sir William's report on the Humber, which was prepared in 1905, is regarded as a record containing data of considerable value for reference on questions which affect that river.

During late years Sir William had been a member of several Commissions and Committees, such as the Royal Commission on Coast Erosion in 1906; the

International Technical Commission on the Suez Canal in 1908; and the Royal Commission on Oil Fuel and Engines in 1912. He was President of the Institution of Civil Engineers for the session 1907–08, and was chairman of the Committee on Cement of the British Standards Association from its inception onwards. He was also chairman of the Committee on reinforced concrete set up by the Institution of Civil Engineers in 1908. Sir William was made C.M.G. in 1901 "for services in connection with colonial harbours," and promoted in the Order to a Knight Commandership in 1906. He was also an Officer of the Order of Leopold, which was conferred on him and also upon his late partner, Mr. J. C. Coode, for services in connection with the harbour of Zeebrugge.

Naval Construction in 1921.

Great Britain.

ALTHOUGH the Navy Estimates for 1921–22 contained provision for the building of four capital ships, none of those vessels had been actually laid down by the end of the year. The pause in heavy naval construction has therefore lasted nearly three and a-half years, no new keel having been laid since the launch of the Hood in August, 1918. The intention was, we believe, that work should begin on two of the new battle-cruisers before the close of the year. But in view of the American proposals for the limitation of naval armaments, as promulgated at Washington on November 12th, and at once accepted in principle by the British Government, the execution of the shipbuilding programme has been suspended, and at the time of writing it appears improbable that any of the vessels will be built to the original design. As the First Lord of the Admiralty explained in his memorandum on the Estimates, published on March 12th, it had become impossible longer to disregard the necessity of replacing the obsolescent material of the battle fleet by modern ships, embodying the lessons of the war. "In this connection," it was added, "it must be remembered that no capital ship for the Royal Navy has been laid down and completed since 1916, and it is obvious that, as the Fleet is reduced in numbers, the ships of which it is composed must be of up-to-date type and of the highest efficiency." A sum of 2½ millions was therefore set aside as a first instalment for "replacement" ships. Upon Nos. 1 and 2 it was proposed to expend £529,980 each during the current financial year; upon No. 3, £365,243; and upon No. 4, £359,144. A further sum of £177,500 was to be spent on the hull, fittings and equipment of each ship, the balance of the expenditure being devoted to propelling and auxiliary machinery, gun mountings, torpedo tubes, &c. Particulars of the four new ships were not divulged. The Parliamentary Secretary to the Admiralty stated in the House of Commons that they would be battle-cruisers of the "Hood" type, but with improvements in the matter of protection and armament which would interpret war experience and enable them to hold their own with any vessels of their class in other navies. In view of the fact that all American and Japanese capital ships laid down since the Hood were being armed with 16in. guns, we had been obliged, he said, to follow their example, and the four ships would therefore be armed with 16in., not with 15in. guns. On the other hand, Mr. Amery added, the dimensions of the ships—and that had been a cardinal principle of their design—would be kept within such limits as to obviate the necessity of providing any larger docks or port accommodation other than that already existing, from which statement it was inferred that the speed would be rather less than that of the Hood. In former years it had been the custom to allot one capital ship of each programme to Portsmouth and Devonport respectively. Dimensions, however, have grown so rapidly that the slips at those yards cannot accommodate vessels of the "Hood" type, and to lengthen them sufficiently would have involved nearly two years' work. Consequently, as the new ships were urgently needed, it was decided to have all four built by contract; but it was officially intimated that the work of lengthening the berths at Devonport and Portsmouth, at an estimated total expenditure of £1,000,000, would have to be undertaken eventually. Late in October the battle-cruiser contracts were placed, as follows:—

(1) The Fairfield Shipbuilding and Engineering Company, Limited, Govan.

(2) John Brown and Co., Limited, Clydebank.

(3) Swan, Hunter and Wigham Richardson and Co., Limited, Newcastle-upon-Tyne; machinery by Parsons Marine Steam Turbine Company, Limited.

(4) Beardmore and Co., Limited, Dalmuir; machinery by Vickers Limited.

In announcing these orders the Parliamentary Secretary stated that probably some 5000 men would be employed in the shipyards, engine works and steel works during the ensuing two months, and that in the New Year that number would rapidly increase to about 25,000 men. No estimate could then be given as to the number of men for whom employment would be found in mines, transport, &c., but the total so employed would, of course, be very considerable. The number of firms that would be interested to a greater or less extent in actual building or in providing material would probably be in the neighbourhood of 500. As far as could be foreseen, the cost of the four ships would be approximately £30,000,000, of which about three-fourths would represent wages.

Effect of the Washington Conference.

The placing of these important contracts was hailed with more than ordinary satisfaction by the shipbuilding and affiliated industries, which had been suffering severely from the combined effect of the *post bellum* suspension of naval construction and the limited demand for new mercantile tonnage. It was expected that blast-furnaces, foundries, armour plate mills and gun factories which had been practically idle for three years would again become active, with corresponding benefit to the labour market and the wage-earning community in general. These hopes, however, were speedily shattered by the proceedings at the Washington Conference. The American proposals, aiming at the complete cessation of all capital ship construction in the United States, Great Britain and Japan, were approved in principle by the British Government, and on November 17th the firms which had secured Admiralty contracts were requested not to proceed with them till further notice. Our correspondents in the industrial centres concerned have described the effects of this cold douche on the industries affected. There was, and still is, a widespread feeling that the decision was somewhat premature, particularly in view of the fact, since ascertained, that neither in the United States nor Japan was there any immediate interruption of the naval shipbuilding then in progress. Since the American scheme was submitted to the Conference it has undergone certain modifications, owing to Japan's reluctance to part with the battleship Mutsu. To balance her retention of that ship and the consequent dislocation of the tonnage ratios originally proposed, it has been decided that the United States shall complete two unfinished battleships and Great Britain lay down two new vessels. This, however, does not necessarily mean that two of the battle-cruisers will be proceeded with, for their displacement would be considerably in excess of the 35,000-ton limit prescribed for all new construction. As, according to the latest information, this limit is to be adhered to, the plans will presumably have to be revised on the basis of lower displacement; but it would be futile at this stage to speculate as to their probable characteristics. The definite fact that emerges from the naval agreement signed at Washington is that our shipbuilding programme is to be reduced by half, and two of the battle-cruiser contracts will be countermanded. Regrettable as this course may be from the industrial point of view, it is considerably better than the complete stoppage of all heavy naval shipbuilding which appeared to be imminent a few weeks since. We have grown so accustomed to the gigantic size of ultra-modern capital ships that 35,000 tons may seem quite a modest displacement. Actually, however, it is larger than that of any battleship which has been completed up to now, being 1200 tons more than the Nagato or Mutsu, 2400 tons more than the Maryland, and 7500 tons more than the Queen Elizabeth, which is the heaviest battleship type in the Royal Navy. The only completed warship in the world which surpasses the 35,000-ton limit is the battle-cruiser Hood, of 41,200 tons. While, therefore, it will manifestly be impossible to endow our two new vessels with all the qualities of the Hood, the ingenuity of our naval constructors will doubtless prove equal to the task of preparing a battleship design in which are embodied the maximum powers of offence and defence compatible with the lower displacement in question.

Work continued at a leisurely rate during the past twelve months on the residue of the war-time programme. The only important vessel that remained on the stocks when the year opened was the light cruiser Effingham, and she was launched at Portsmouth on June 8th last. She belongs to the "Raleigh" class of large cruisers, specially designed for commerce protection, full details of which have already appeared in our columns. The Effingham and her sister, Frobisher, which was put afloat in March, 1920, are being completed very slowly, no date having been assigned for commissioning either of them. The only other light cruisers remaining to be completed are the Despatch and Diomede, of 4765 tons and 29 knots, and the Emerald and Enterprise, 7600 tons and 33 knots, all of which are expected to pass into service during the present year. These vessels, with two flotilla leaders, four destroyers, and three or four submarines—all of which are in the water—represent the balance of the war programme. The only war vessel of any description now on the stocks is a submarine which was authorised under the current Estimates and laid down at Chatham on November 1st. According to statements which have appeared in the Press, this boat is to be of a large ocean-going type, but no details are available. The Estimates provide also for a new mine-layer, to be built at Devonport. She has not yet been laid down, and nothing is known of her characteristics.

United States.

The naval reduction scheme adopted at the Washington Conference will practically cancel the American shipbuilding programme of 1916, so far as capital ships are concerned. That measure provided for ten battleships and six battle-cruisers, with a total displacement of 640,600 tons. Only one vessel, the battleship Maryland, has been completed to date, and two others of the same type, Colorado and Washington, are to be retained under the amended limitation scheme; but the remaining seven battleships and six battle-cruisers are not to be proceeded with. This decision will, of course, involve a considerable sacrifice of money, but the loss would have been far heavier had not the ships been constructed very slowly during the past twelve months. The following table shows the percentage of completion, on October 1st, 1921, of the thirteen ships which are marked down for demolition:—

	Per cent.
Battleships—	
West Virginia	62.5
South Dakota	34.6
Indiana	32.5
Montana	27.6
North Carolina	36.6
Iowa	29.5
Massachusetts	10.4
Battle-cruisers—	
Lexington	25.5
Constellation	14.5
Saratoga	28.4
Ranger	2.7
Constitution	11.1
United States	10.7

With the exception of the West Virginia, which belongs to the "Maryland" class, all the discarded vessels were remarkable for their extraordinary size and power. The six units of the "Massachusetts" class, each displacing 43,200 tons, would have been the largest battleships in the world, surpassing even H.M.S. Hood and the Japanese vessels Kaga and Tosa. The six battle-cruisers were to have been still heavier, displacing 43,500 tons each, and their machinery was designed for a maximum of 180,000 horse-power. As all these vessels were described in THE ENGINEER of March 4th, 1921, it is unnecessary to repeat their details here. It may be said, however, that American naval opinion was not greatly enamoured of the design of either the 43,200-ton battleships or the battle-cruisers, both having been criticised as too ambitious, too costly, and too experimental. Particularly in the case of the battle-cruisers, grave doubts had been expressed as to the wisdom of striving to obtain such tremendous power from the electric drive system, in regard to the merits of which there is still a certain amount of controversy. From 28,900 shaft horse-power—the maximum figure in the "Maryland" class—to 180,000 shaft horse-power in the battle-cruisers was felt to be a jump that was not warranted by the comparatively limited experience which has been obtained. These doubts were strengthened by the not entirely favourable results of the steam trials of the Tennessee, an earlier battleship equipped with the electric drive. It was further rumoured that the protection of the battle-cruisers was inadequate. Apart from these technical criticisms there was a growing suspicion that by the time all these huge capital ships had been completed their original value would be found to have depreciated very considerably owing to recent developments in aerial and submarine warfare. Last year's bombing experiments against the Iowa, the Alabama, and the Ostfriesland and other ex-German ships made a profound impression in the United States. The sinking of the Ostfriesland—a fairly modern and extremely well-protected battleship—by two heavy bombs which exploded in the water close alongside, was declared by many observers, including naval officers, to have sounded the doom of the great ship, and several months before the Washington Conference held its inaugural session a Press campaign for the suspension of work on the capital ship programme was in full swing. Whether these circumstances had any bearing on the proposals subsequently made at the Conference for the scrapping of all unfinished heavy ships can only be conjectured, but it seems certain that American naval opinion as a whole is more reconciled to the loss of the ships than it would have been before the bombing tests.

Three American battleships were launched during the past year: the Colorado on March 22nd, the Washington on September 1st, and the West Virginia on November 19th. The West Virginia was built at Newport News, the other two at Camden, N.J. These complete the "Maryland" class, the name-ship having been launched in 1920 and completed last summer. Leading details:—Length, 600ft. on water line, 624ft. over all; breadth, 97ft. 3½in.; mean draught, 30½ft; displacement, 32,600 tons normal, 33,590 tons at full load. Machinery: turbines with electrical drive, designed shaft horse-power 28,900, for a speed of 21 knots; steam supplied by eight Babcock and Wilcox boilers, oil fired. Armament: eight 16in. 45-calibre guns in four turrets; fourteen 5in. 51-calibre quick-firing guns; four 3in. anti-aircraft guns; two submerged torpedo tubes. Complement, 1410. As stated above, the Colorado and Washington are to be completed, but the West Virginia is to be broken up. These are the first modern American ships to have a 16in. belt of armour.

Steady if somewhat leisurely progress has been made

with the light cruiser programme, the execution of which is not affected by the limitation scheme. The Omaha, first of the ten scout cruisers authorised in 1916, was launched in December, 1920, and is now about to make her preliminary trials. Three others of the same type were put afloat during 1921—the Milwaukee on March 24th, the Cincinnati on May 23rd, and the Richmond on September 29th. The remaining six will all be launched in the present year. Designed originally on a 7100-ton basis, modifications made in 1920 have strengthened the armament and increased the displacement to 7500 tons, with a corresponding reduction in speed from 35 knots to 33.7. The length between perpendiculars is 550ft., overall 555½ft.; breadth, 55ft.; mean draught, 13½ft. The machinery will be Parsons or Curtis turbines with reduction gears, developing 90,000 shaft horse-power at full power, equivalent to 33.7 knots. As increased, the armament consists of twelve 6in. 53-calibre quick-firing guns, four mounted in two-gun turrets on the forecastle and after deck, and the remainder in lightly armoured casemates in proximity to the turrets. This arrangement facilitates concentration and fire control, but has the disadvantage of exposing several guns to disablement by a lucky hit. The Omaha and her sisters will be the swiftest light cruisers in the world, with the possible exception of certain Japanese vessels now building. They are faster by nearly three-quarters of a knot than our cruisers of the "E" class. Irrespective of twelve boats—Nos. 348 to 359 inclusive—which have been authorised but not yet begun, the residue of the big war programme of "flush-deck" destroyers was cleared off during the past year, and no vessels of this type now remain on the stocks. From twenty to thirty submarines were under construction at the end of the year. The majority of them belong to the "S" class, comprising fifty boats in all, with displacements averaging 900 tons, a speed of 14 to 16 knots on the surface and 11 knots below water, and an armament of one 3in. gun and four torpedo tubes. Two large "fleet submarines," T 2 and T 3, of 1100 tons and 20 knots surface speed, were completed during the year. In November the keels of two new "fleet submarines" were laid at the Portsmouth, N.H., Navy Yard. According to unofficial details, they are to be 300ft. in length and of 2025 tons displacement. The machinery is described as "a combination of gas and electric propulsion," developing 6500 horse-power, is to give a speed of 21 knots on the surface and 10 knots submerged. This may be an adaptation of the Diesel-electric drive first installed in the British "K" class submarines. The new American boats are designed for a cruising endurance of 10,000 nautical miles. They will be armed with one 5in. gun, on a mounting enabling it to be used for high-angle fire, and six torpedo tubes, for which sixteen torpedoes will be carried. Naval auxiliary ships under construction are the repair ship Meduse, the destroyer tenders Dobbin and Whitney, the submarine tender Holland, the aircraft carrier Wright—converted from the ex-collier Jupiter—and the small gunboat Tulsa.

Japan.

The effect of the Washington reduction scheme will be to render null and void the capital ship programme which passed the Imperial Diet in July, 1920, authorising the construction of four battleships and four battle-cruisers. Furthermore, the scheme necessitates the cancelling of four large vessels which are approaching completion, viz., the battleships Kaga and Tosa, 40,000 tons each, and the battle-cruisers Amagi and Akagi, of about 41,000 tons each, together with the battle-cruisers Atago and Takao. The keel of the Atago was laid at Kobe on November 25th, but three weeks later it was announced that further work on the ship had been abandoned *sine die*. The Takao will not now be commenced. In all, therefore, Japan is called upon to forfeit fourteen capital ships, including nine which had not been laid down. After a great deal of negotiation at Washington it was decided that she should retain the battleship Mutsu, a sister of the Nagato, the necessary adjustments being made in the tonnage ratios assigned to the British Empire and the United States. A full description of all the Japanese vessels named above was published in THE ENGINEER of November 25th last. The Kaga, one of the condemned battleships, was begun at the Kawasaki yard, Kobe, in July, 1920, and launched on November 17th of last year. Her sister ship, Tosa, was laid down at Nagasaki in February, 1920, but up to the present her launch has not been reported. Both vessels are to be broken up. The battle-cruisers Amagi and Akagi, also condemned, are very near the launching stage at the Government yards of Yokosuka and Kure respectively, and will doubtless be put afloat in order to clear the slips. The light cruiser Nagara, 5570 tons, was launched at Sasebo on April 25th. She is very similar in all respects to the "Kuma" class, being designed for a speed of 33 knots and an armament of seven 5.5in. guns. Sister ships are the Isudzu and Natori. All these later light cruisers are understood to be oil burners. Those completed have made very successful trials, achieving their designed speed without difficulty. Their fuel capacity, and consequently their steaming radius, is somewhat greater than that of British vessels of equivalent size. It is not known whether any of the twelve light cruisers authorised in 1920 have been commenced. About twenty destroyers, including several first-class boats of 1500 tons, are in varying stages of construction. The only intelligence as to submarine progress is derived from Press reports of doubtful authority. In October last the Osaka journal *Mainichi* wrote:—"The construction of submarines for the Japanese Navy is being steadily carried out. Recently three submarines, one at Sasebo and two at Yokosuka, were launched, and there are now nine others under construction at the Kure, the Yokosuka, and the Sasebo naval arsenals, and the Kawasaki private yard. These are all medium-size boats, of 800 to 900 tons." Reports from other sources indicate that several submersible cruisers, of 2000 tons or more, are building in Japan. In an interview published last November, the Vice-Naval Minister, Admiral Ide, said that the Navy Department was then fully occupied in working out problems arising from the sudden cessation of work, involving heavy liabilities on the part of the Government and making provision for idle workmen, a problem with which neither Great Britain nor America was faced in the same degree. Considering her industrial position, Japan, he said, could not cease naval work suddenly without causing widespread distress among hundreds of thousands of people dependent on the workers. He added, however, that as soon as Washington had reached an agreement the work on order would be stopped both in private and State yards without regard to consequences. The Japanese papers state that, as all the yards in the country are now mainly dependent on naval contracts to keep them employed, the enforcement of the "naval holiday" may administer the death-blow to the shipbuilding industry.

France.

Although the French naval programme was adopted last April, it is not believed that work has been begun on any of the ships which were voted. The programme of new construction embraces six cruisers, twelve large and twelve medium destroyers and thirty-six submarines, and authorises the conversion of the uncompleted battleship Béarn into an aircraft carrier. Building operations will probably commence at an early date, for on December 9th the Chamber voted the sum of 160 million francs for disbursement on new construction during 1922. The six cruisers have been re-designed on a larger scale. They will displace 8000 tons and have a speed of 35 knots, while the armament will consist of a new mark of 7.6in. gun, of very high velocity. A complete armour belt and strong deck protection will be fitted. These will be the first light cruisers to be built for the French Navy for well over twenty years. The twelve large destroyers will be of 2400 tons displacement, and the twelve medium boats of 1400 tons. The displacement of the thirty-six submarines is expected to average 1000 tons. A large amount of reconstruction work was done during the past year, the vessels so treated including three battleships and the five ex-German light cruisers surrendered to France under the Peace Treaty. The destroyer Enseigne Gabolde, laid down in 1913 but on which work was suspended during the war, was launched on April 22nd.

Italy.

Italian yards have been working on the balance of the war programme, which includes three "scouts," of 2200 tons, fourteen destroyers of 800 to 900 tons, and seven gunboats. In February last a new naval Bill was introduced and passed, providing for the construction of two light cruisers, each of 5000 tons; four 900-ton destroyers, four 600-ton submarines, eight small minelayers and supply ships, an oil tanker of 7000 tons, and several armed motor launches. So far as is known, all these vessels are still in the designing stage. The battleship Leonardo da Vinci, whose salvage last year constituted one of the most remarkable engineering feats of its kind ever achieved, is not to be reconditioned as a warship. There is some talk of converting her into an oil tanker.

Minor Navies.

The keel of a new light cruiser for the German Navy was laid at Wilhelmshaven. The vessel is to be of 5600 tons displacement, and is designed for a speed of 30 knots. The armament will be eight 5.9in. guns and four torpedo tubes.

The Spanish battleship Jaime I., which was laid down as long ago as 1912, ran her steam trials last May. Except for the armament, the vessel was completed and her machinery tested in May, 1915, but owing to the war it was impossible to secure delivery of the heavy guns and mountings from the manufacturers—Vickers Limited and Sir W. G. Armstrong, Whitworth and Co., Limited. The two sister ships, España and Alfonso XIII., have been in service six years. All three vessels are uniform in dimensions, &c., displacing 15,452 tons; maximum speed, 19½ knots; main armament, eight 12in. 50-calibre guns. The whole of the machinery was manufactured at the Ferrol works of La Sociedad Española de Construccion Naval, where the ships were built. The steam trails of the Jaime I. were very satisfactory, a mean speed of 20.028 knots being obtained in four runs over the measured mile. Work is proceeding at the Ferrol yard on two light cruisers—one said to be named Almirante Cervera—of 4725 tons and 29 knots speed, while the Cartagena yard has in hand three large destroyers and six submarines.

A naval programme for the defence of the Homeland and the Colonies was introduced by the Netherlands Government last November. It is limited to destroyers, submarines and aircraft, and, in view of the financial position, is to be spread over a period of six years. The light cruiser Sumatra was launched at Amsterdam on the penultimate day of 1920, but her sister ship, the Java, is still on the stocks at Flushing. The Celebes, a third vessel of this type, has been cancelled. The Sumatra and Java are vessels of 7050 tons, 30 knots speed, and an armament of ten 5.9in. Krupp guns. A number of submarines are in hand. In January last it was reported from Berlin that the Netherlands Government had placed an order with the German firm of Thiess for eighteen submarine engines, six of 450 horse-power and twelve of 1200 horse-power, the boats for which were to be built in Dutch yards.

There is scarcely any new construction in progress for the Scandinavian navies. Sweden has completed the Gustav V., third of the "Sverige" class of small coast-defence battleships; Norway is building two submarines, and has ordered two more from the United States; and Denmark has decided to transform the uncompleted monitor, Niels Juel, into a cruiser, with a quick-firing armament. This vessel was to have carried two 12in. guns.

Various naval projects are under consideration in the South American States, but nothing definite has emerged up to now. It is to be apprehended that the clause in the Washington agreement which forbids the signatory Powers to sell existing warships to other States or construct new vessels for foreign account will not only hamper the development of minor navies, but deprive British shipbuilders of a class of business which has proved lucrative to them and highly satisfactory to their foreign customers.

FOUNDRY TRADES EXHIBITION.

AN International Foundry Trades Exhibition, which has been organised by the Birmingham Chamber of Commerce (Incorporated), the Institution of British Foundrymen and the British Cast Iron Research Association, is to be held in Bingley Hall, Birmingham, from June 15th to 24th next. In the "Foreword" of the notice announcing the Exhibition, it is explained that the occasion of the Foundrymen's Conference has been fixed upon as the opportune moment to present a comprehensive display of all equipment appertaining to foundry practice.

The exhibits will be divided under heads as follows:—General foundry plant: Cupolas, electric furnaces, annealing ovens, furnaces, gas producers, core ovens, core racks, core makers' benches, sand sifters, sand mixers, moulding machines, core machines, sand blast machines, tumblers, grinding machines, dust arresters, pressure blowers, pressure fans, turn-tables, foundry cranes, charging trucks, foundry trucks, crane ladles, truck ladles, hand ladles, cinder mills, moulding boxes, flasks, briquetting machines, scrap machines, welding plant, pneumatic tools. Foundry requisities: Facings, shovels, riddles, brushes, core oil, binders, core rope, studs, chaplets, etc., cupola tools. Pattern making of all kinds: Wood machinery, pattern making lathes, trimmers, circular saws, sandpapering machines, etc. Moulding sands of all kinds. Laboratory equipment: testing machines, pyrometers, thermometers, etc. Refractories: cupola linings, gannister, bricks, etc. Die casting plant, permanent moulds, etc. Combined exhibits by British Trade Groups, including (*a*) Grey foundry work; (*b*) Malleable foundry work; (*c*) Semi-steel exhibits; (*d*) Cast iron rolls; (*e*) Non-ferrous foundry; and (*f*) Steel castings. Raw materials and fuel: pig iron, alloys, scrap, etc. Transport and handling appliances. Finished goods (British only): cast iron—architectural ironworks, baths, centrifugal castings, coal vases, fenders, fire dogs, fire irons, gas and electric fittings, gates and railings, gas and oil stoves, holloware (enamelled and tinned), motor car castings, pipes and fittings, rain water goods, ranges, stoves, fire grates, registers, mantels, sad irons, sanitary castings, stable castings, staircases, sewerage castings, tables (parts for), umbrella stands, waterworks castings; Steel: steel castings. Non-ferrous: die castings, aluminium castings, general castings, alloys, die casting plant. Complete foundry, with modern equipment. Foundry, office and works organisation requisites. Technical educational institutions, associations and publications, trade Press publications. There will also be a competition for core making, moulding, pattern making, etc. Historical and statistical exhibits (honorary). Technical lectures and papers by various technical societies; and publicity and propaganda exhibits, including cinema demonstration. The Exhibition is primarily for business purposes, but special attractions will be provided in the shape of lectures by experts on subjects coming under the headings which comprise the objects of the undertaking. A prominent feature will be a special series of films showing processes of organisation, equipment and manufacture demonstrated by cinematograph. Further particulars may be obtained by applying to the general manager, International Foundry Trades Exhibition, Chamber of Commerce, 95, New Street, Birmingham.

IT is reported that large consignments of German goods have recently been arriving in Argentina. These include agricultural machinery, boiler tubes, barbed and fencing wires, constructional iron, paint, pianos, rails, refrigerators, sewing machines, and steel tubes.

Hydro-Electric Installation at Denbigh Asylum.

AN interesting application of hydraulic power for the supply of electricity on a comparatively small scale has recently been carried out at Denbigh in Wales. In 1919 the North Wales Counties Asylum authorities instructed Mr. S. E. Britton, M.I.E.E., who is responsible for the hydro-electric installation at Chester, to report to them upon several water resources situated within a few miles radius of the Denbigh Asylum, with a view to utilising that form of power in place of their existing steam plant for generating electricity. As a result of Mr. Britton's inquiries, it was decided in 1920 to develop a scheme on the river Ystraad, which passes through land belonging to the Asylum, and applications were made to the Lunacy Commissioners and to the Ministry of Health for sanction to proceed with the necessary work. The site selected for the hydro-electric installation is only about 400 yards distant from the Asylum. The area of the catchment utilised by the installation is 17 square miles, and the average rainfall in the district is 50in. per annum, from which data it was calculated that the erection of a dam to give a fall of 15ft., together with a reservoir covering an area of three acres would provide power sufficient to produce 200,000 units of electricity per annum.

The scheme was rather expensive to carry out, as it involved the erection of a dam 160ft. long across the valley of the river, a fish pass to enable fish to have access to the river above the dam, and a generating station in which are installed a water turbine, an electric generator and switchgear. A specification was prepared and sent to several contractors, but owing to the unsettled state of labour, the high cost of materials and the difficulty of obtaining them, no tenders were submitted. The Asylum authorities therefore empowered Mr. Britton to make the best arrangement he could to carry out the work by direct labour or otherwise, and a contractor was eventually found who was prepared to carry out the excavations and concrete work to a schedule of prices, subject to fluctuations in the cost of labour and material. Fig. 7 shows the general lay-out of the scheme, the ground level of the valley, the depth to which excavations had to be carried, and sections of the dam and fish pass. Fig. 8 is a plan and section of the power-house, while in Figs. 1 to 6 inclusive are given a number of engravings reproduced from photographs of the work taken during and after construction. Messrs. J. Gordon and Co. contracted for the supply and erection of the turbine, generator, switchboard, sluice gates and strainer rack, but the remainder of the work was carried out by direct labour. The turbine is of the Francis vertical shaft type, and is designed to develop 120 horse-power at 270 revolutions per minute, when operating under a fall of 15ft. The generator, which is also of the vertical shaft type, is direct coupled to the turbine, and has an output of 700 ampères at 120 volts. Two 0.75 square inch paper-insulated lead-sheathed and steel-armoured cables, laid direct in the ground, connect the generator with the main switchboard in the existing power-house at the Asylum, where a steam generating plant, capable of supplying 85,000 units per annum, has been in use for some years. The water power installation will now replace the steam plant, and it is intended to install additional electric apparatus so as to utilise to the full the output of the hydro-electric plant.

The cost of the scheme has been about £9000, or about £70 per horse-power, and it is anticipated that the saving effected in coal and labour will be sufficient to defray the outlay on the installation in about ten years. The generating plant will operate in conjunction with storage batteries which are already installed for the steam plant, and the surplus energy from the hydro-electric plant will probably be used for general heating purposes, and for heating water during the night when the demand for current for ordinary purposes is low.

FIG. 1—SITE OF RESERVOIR

FIG. 2—WOODEN FORM FOR DRAUGHT TUBE

FIG. 3—DAM DURING CONSTRUCTION

FIG. 4—DAM DURING CONSTRUCTION

FIG. 5—POWER HOUSE AND FISH PASS

FIG. 6—POWER HOUSE AND DAM COMPLETE

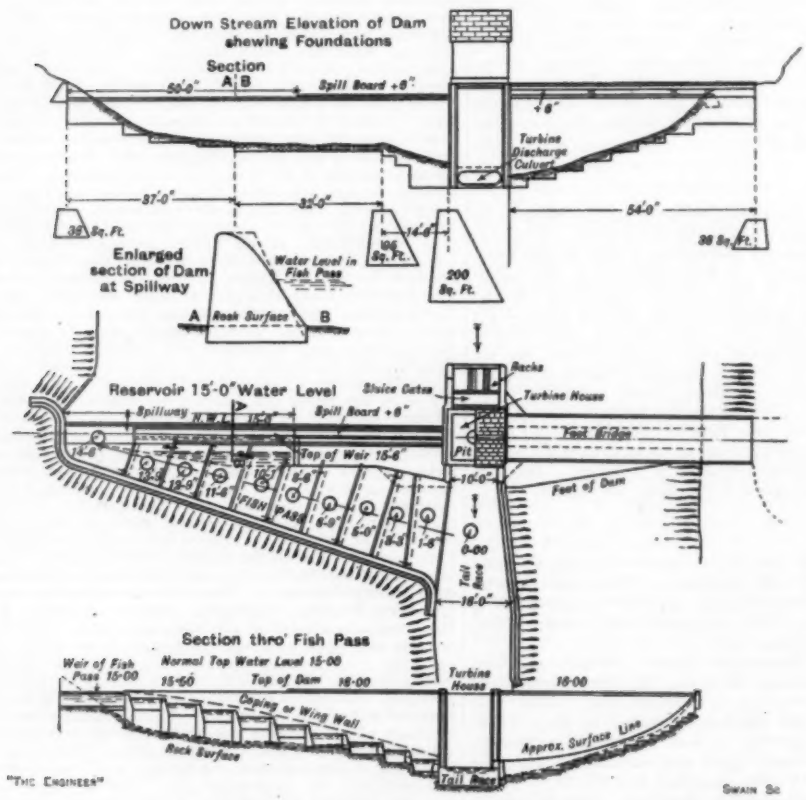


FIG. 7—GENERAL ARRANGEMENT OF PLANT

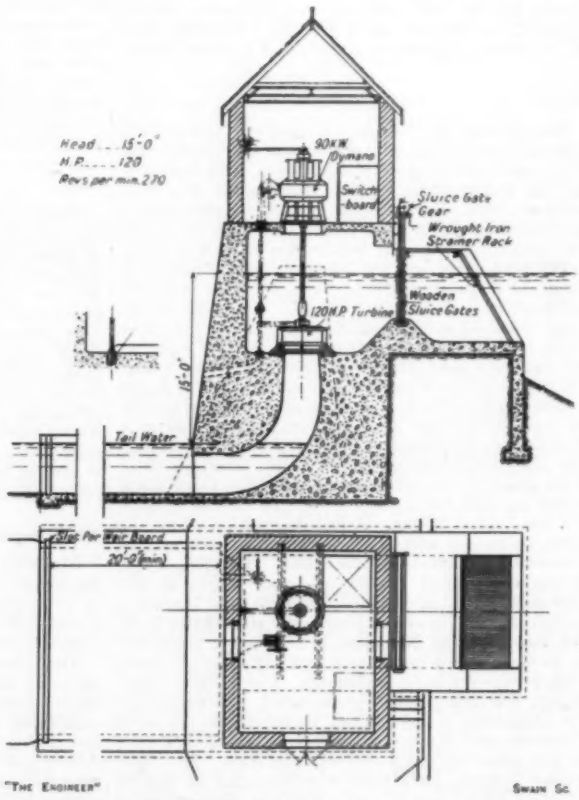


FIG. 8—SECTION AND PLAN OF POWER HOUSE

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE PANAMA CANAL SLIDES.

SIR,—Your correspondent "D. M. M." asks me to explain the following sentence in my article on "The Problem of the Panama Canal Slides": "It is very probable that what has occurred at Culebra as a result of man's interference, is constantly occurring in nature as a result of erosion acting through long periods of geological time."

The excavation of a deep cut for a canal may be compared with the excavation of a deep valley by the ordinary processes of nature working with her usual tools—rain and rivers. But what engineers can do in a decade, may take nature a million years to accomplish. In his classic text-book of geology, Geikie attempts an estimate of the rate of erosion of a river valley, and he finds that, at the rate he assumes, a valley of 1000ft. deep may be excavated in 1,200,000 years.

We also know from the comparatively recent science of geophysics, in dealing with the subject of the fracture and flowage of rocks, that most rocks near the surface of the earth, when subjected to sufficient stress, suffer rupture, with the production of joints and faults. But geophysicists also believe that at a great depth rocks become deformed, not by fracture, but by flow. Certain changes of a mechanical, mineralogical and chemical character are brought about in the internal structure of a deep-seated rock, whereby there is produced in many cases a parallel arrangement of the constituents, so that the rock without loss of integrity may acquire cleavage or schistosity. The zone of flowage characterised by these changes is not limited to any definite depth, but varies in different rocks and in the same rock under different conditions, depth being only one factor in determining the flowage. It is only when a deep cut, either natural or artificial, is made down into this flowage zone that actual motion of the mass may result. As regards molar motion, in contrast to molecular motion, the "flowage" is only potential.

Any deep excavation in the crust of the earth, such as a railway cutting, a mine gallery or shaft, or a canal cut, sets up strains in the adjacent rocks. These strains are due to the unbalanced pressures caused by substituting the pressure of the atmosphere for the much greater pressure of the material which has been excavated. In the case of Culebra Cut, Dr. McDonald, the Canal geologist, points out that there are two kinds of these internal strains. First, there are the tensional or flowage stresses which cause a horizontal strain toward the excavation, and give maximum deformation near the surface high above the Canal level. Then there are the crushing or direct gravity stresses which have a maximum effect near the toe of the steep slope of the excavation at the bottom of the Canal. The resultant of these two groups of stresses is called by McDonald the straining, or slide-producing factor.

Two kinds of excavations—one natural, the other artificial—set up strains in their slopes or in the adjacent rocks which may result in slides. The natural causes are erosion by streams, fault escarpments and other processes of nature, while the artificial ones are open cuts, underground openings, submarine excavations and other works of man.

As a good example of such a natural cutting, we may take a canyon, *e.g.*, of Colorado, in an arid district where there is little rainfall to interfere with the verticality of the sides. Canyons are deep valleys with steep sides, which have been formed naturally by the down-cutting or corrosion of a stream. Culebra Cut—or Gaillard Cut, as it is now called, from the engineer who directed the cutting—is an artificial canyon. It may be considered to be a deep valley with steep sides, but it was formed artificially by the down-cutting of a battery of steam shovels.

The question then arises, "How is it that canyons persist when they are formed by the ordinary forces of nature acting throughout long periods of time, but give way when they are formed by the interference of man?" The answer to this is that of the canyons formed by natural agencies, some give way and some persist, according to the nature of the rocks which form the steep sides. In the case of very deep canyons, we find that these sides are formed of very resistant rocks; in fact, the depth of the canyon is usually related to the power of resistance to compression of the rocks which form their sides. But those canyons which were formed by down-cutting through weakly resistant rocks have disappeared in the course of time. That this is so, will be apparent from the following considerations:—

There is going on all the time, and has been going on throughout geological times, a general lowering of the land due to subaerial denudation. There is also going on at a greater rate, probably about ten times as great, a local lowering of the land due to the erosion of rivers, or corrosion as it is sometimes called. This may go on till a valley of 1000ft. deep is excavated, say, in a million years—see Geikie's "Geology," page 592—if the rocks through which the excavation is made are sufficiently resistant. If these rocks are not resistant, a slide will occur long before that depth is reached. If the rocks are very resistant, as in the Yosemite Valley or the canyons of the Colorado, a much greater depth may be reached before such a slide occurs.

After a slide has occurred in this natural way, the forces of subaerial denudation continue at their work of lowering the general surface of the land, and all traces of these natural slides are removed as completely as the slide material at the Panama Canal has been removed by the American engineers.

While the Panama Canal was being excavated, the material of which Culebra Hill was composed was so hard that it had to be blasted before it could be removed. That material was so hard that it might quite properly be called rock, and if that rock had retained its original qualities, it is quite probable that Culebra Cut would never have given rise to the present very troublesome Culebra slides. But the rock was not permitted to retain its original properties because of the mechanical effects of rain. When certain rocks absorb rain water, it causes them to swell. The Culebra rock became so soft after a few months' exposure to the tropical rains of that district, that they did not require to be blasted, but could be excavated with the steam shovels.

London, January 6th. JOHN STUART.

BOILER ECONOMY.

SIR,—The letter from your correspondent "Nicodemus" raises, I think, a question of very great interest in these days of national poverty, viz., how far is the addition of regenerative and heat-saving appliances to steam plant justified by the face economy it achieves? Undoubtedly, the answer should come from the accountancy side, but hardly is a plant equipped than something new supplants it, and by the time users have learnt from experience that interest on capital and increased maintenance charges have possibly swamped the economies effected, some new system is being boomed. There is no denying that this unprogressive circle from the original users' point of view, is beneficial to trade generally, since capital is operating usefully to employ labour in and about the manufacture of the appliances in question, but it almost seems so far as steam at least is concerned as if the apex had been reached.

Personally, I recall the Rhondda Valley, when the "cough" of the big winding engines was a memorable feature of a visit thereto. That "cough" is now "cured" (?) by regenerative systems, exhaust steam turbines, and what not, but coal is no cheaper—indeed, nearly twice the price it was then—though other factors enter here, and I admit the argument is more illustrative than convincing. However, if it is, in fact, presently to be proved that the economic Rubicon has been reached in steam development, it is clear that the only other flexible power for all purposes is electricity, and it becomes a question of generation as cheaply as possible.

Tidal schemes have been shown as possibly dangerous to the navigable channels they may indirectly affect, as well as being very costly. Natural water "heads" are few in this country. Internal combustion prime movers remain, and no doubt will in the future develop considerably, but I venture to suggest that there is a class of internal combustion-hydro combination which, suggested as far back as 1909 by the inventor of the Humphrey pump, is well worth the attention of engineers. I allude to the operation of water turbines by head pressures created artificially against an air pressure by pumps of this type.

Having recent occasion to discuss this with leading turbine makers, I was not in the least surprised when they raised the question of complication as an objection, but I venture to submit that this is more apparent than real.

The internal combustion pump is a machine of intense simplicity and high efficiency. I know little of turbine efficiency, but believe it likewise to be very satisfactory. The first cost of the combined machine should compare very favourably with Diesel or gas engine construction. It would require a minimum of attention and little lubrication—a not unimportant item in internal combustion prime movers. In fact, space alone can be fairly urged against it if its overall efficiency, as Mr. Humphrey claimed as far back as 1909 was the case, is superior to that of the normal type plant, and this still holds good.

In marine work, apart from hydraulic propulsion which with a uniflow pump of this type should have great possibilities—I do not think the "surge" effect of the Humphrey system would be very suitable for this work—such an internal combustion-hydro combination should be highly effective, and as engineers have accepted the geared turbine, the Diesel-electric and the turbo-electric drives without a qualm, I think the argument against such a combination on the ground of complication collapses; at any rate, to my knowledge efforts are being made to interest manufacturers in such power plants, and it will be interesting to learn whether the regenerative steam and superheating systems will bear comparison. The comparison is gas producer, pump, turbine, dynamo, motor; as against boiler, superheater, engine, condenser, waste heat regenerator, dynamo, motor. I would not care to put forward the suggestion seriously had not eminent engineers and scientists subscribed to it, as the files tell me, as far back as the date quoted; but when closely examined in the light of your correspondent's letter, the idea seems worthy of more consideration than has apparently been given to it in the past, and on the grounds of safety certainly wins "hands down." How it would compare with gas engine stations, I do not know, but the working parts would be very greatly reduced in number, and the lubricant account cut to nothing, while maintenance charges would be vastly in the pump-turbo favour.

I must apologise for trespassing so lengthily upon your space—if you find room for this letter—but the subject rather grips one, and if prejudice alone is preventing its development, it may serve a useful purpose to recall the suggestions of 1909 to mind, in view of the national need for cheap power and fuel conservation.

S. C. CHRISTIE.

Bawtry, Yorks, January 10th.

LOCOMOTIVES WITH FOUR EXCENTRICS.

SIR,—In the history of the locomotive in America it is stated that William T. James, of New York, the inventor of the four-excentric shifting link motion reversing gear, sent his drawings to George Forrester and Co. with the object of getting that firm to construct its engines with link motion reversing gears. From this it may be understood how narrowly Swiftsure, of the Liverpool and Manchester Railway, missed being not only the first British locomotive fitted with four excentrics, but might also have been the first British locomotive fitted with a shifting link motion reversing gear.

Is your correspondent, Mr. Forward, quite sure that official lists of locomotives kept track of the numerous re-buildings that took place in the case of a great many of the early engines? Is it not possible that year after year these lists repeated the descriptions of the engines as delivered?

With regard to Stockton No. 5, of the Stockton and Darlington Railway, there is, of course, no original drawing in existence. Colburn is the only authority for the fact of its being a four-cylinder engine. Nor is there any original drawing in existence of this engine when rebuilt as the Royal George. Colburn's illustration of the Royal George was copied from your pages of 1857, when, in the course of a letter from John Wesley Hackworth, you illustrated a "model" which he had built of the Royal George. It is thus that history is made, but it does not affect the truth regarding the actual engine.

In another letter in your pages of the same year Mr. Hackworth gives particulars of the construction of Nos. 2, 3 and 4 of the Stockton and Darlington, which prove these engines to have differed considerably in their construction from that of Locomotion No. 1. It was from these particulars I made the drawing you were good enough to term "an intelligent guess." These particulars also provide an explanation of what D. K. Clark meant when he stated that Timothy Hackworth invented the first single-lever reversing gear, *i.e.*, he meant first single-lever gab disengaging gear.

If Mr. Forward is content to accept Stockton No. 5 as an engine that required not less than ten handles for its control I have no objection. I can, however, with the aid of Messrs. Robert Stephenson and Co., prove that Experiment No. 6 was the first locomotive to have its crank pins placed at right angles in the wheels fixed on one and the same axle.

The only other engine to which it was proposed to apply the expansion gear of Rocket No. 7 was the Sun and Planet engine, and as the expansion gear of Lancashire Witch was unique, I think Mr. Forward, in his anxiety for accuracy, should be considerably more definite in his reference to "other engines" of the period.

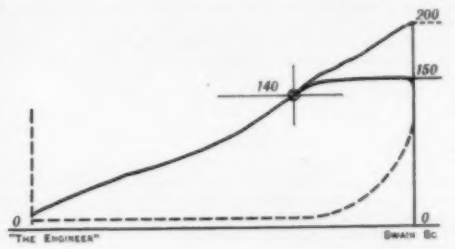
When Stephenson and Co. delivered the Tredegar Iron Company's engine they lost a genius whose later work was performed in a limited sphere, but still was evident in his productions.

JAS. DUNLOP.

Glasgow, January 7th.

MEASURE OF CONSUMPTION, BY CUT-OFF PRESSURE, IN ENGINE CYLINDERS.

SIR,—Will some reader kindly help a student as to the correct method for estimating the consumption of motive fluid—air or steam—in a reciprocating engine? The volume at the point of cut-off is easily determined. Of that there is no question. The rule followed is to take the pressure at cut-off as being the measure of steam introduced into the cylinder, and to take no account of the initial pressure, no matter how much this exceeds the cut-off pressure. Thus, in the diagram, the cut-off pressure is 140 lb. per square inch, both for an initial pressure of 200 lb. and for 150 lb. In the first case, the mean pressure operating



on the piston up to the cut-off point is 170 lb., and in the other case it is only 145 lb. It seems to a novice that in the first case much more energy is introduced into the cylinder than in the second case; yet, by taking the cut-off pressure as the measure of the fluid admitted, a much lower rate of consumption per unit of indicated power is obtained simply because the higher starting pressure in this case is ignored. The high peak given by 200 lb. pressure adds much to the area of the diagram.

Is no more energy really absorbed by the cylinder starting with 200 lb. pressure than when it starts with only 150 lb.? If, for purpose of answer, it is necessary to assume the diagrams to be made with steam, the quality of the steam at cut-off point might be taken as theoretically "dry" in both cases.

January 6th. T. W.

SCAVENGING IN DIESEL ENGINES.

SIR,—On p. 7 of the January 6th, 1922, issue of THE ENGINEER, in an article dealing with the progress of motor ships in various countries, the Nobel-Diesel two-stroke engine. is mentioned It is stated that valve scavenging is retained, but special arrangements are made for supercharging. This statement is rather misleading, as it conveys the idea of scavenging by means of valves in the cylinder heads, which is not the case, as in the Nobel-Diesel engine the scavenging is performed by means of ports at the side of the cylinder. The admission of scavenging air, however, is controlled by a cylindrical sleeve valve placed near the inlet ports and actuated from the cam shaft. Means of supercharging the cylinder are also provided.

Erith, Kent, January 11th. G. STEINHEIL.

PANAMA CANAL SLIDES.

SIR,—I have been most interested in Professor Stuart's reply to "D. M. M.," and I should feel deeply indebted if he will clear up a difficulty which I have felt ever since I recently visited the site of the Panama Canal slides in the company of a Canal employee, who was not, however, a geologist.

I saw no traces of drainage tunnels driven underneath the sliding ground, and as I knew that had been suggested, not only by the Slide Commission, as stated by Professor Stuart, but also by many American newspapers and periodicals, I asked my friend who accompanied me why it had not been done, but he could give me no explanation.

HARRY BATES.

London, W. 6, January 8th.

ERRATUM.—In Mr. Stuart's letter on the Panama Canal slides, published on page 22 of THE ENGINEER for January 6th last, for "direction" in the sixth line of the second column read "directrix."

ROYAL INSTITUTION.—On Tuesday next, January 17th, at three o'clock, Dr. F. H. A. Marshall begins a course of two lectures at the Royal Institution on "Physiology as Applied to Agriculture"; on Thursday, January 19th, Mr. Seton Gordon gives the first of two lectures on (1) "Mountain Birds of Scotland," (2) "Sea Birds and Seals"; and on Saturday, January 21st, Dr. Charles Macpherson, organist of St. Paul's Cathedral, commences a course of two lectures, with musical illustration, on "The Evolution of Organ Music." The Friday Evening Discourse on January 20th will be delivered by Sir James Dewar on "Soap Films and Molecular Forces," and on January 27th by Viscount Burnham on "Journalism."

EXHIBITION OF MATERIALS AND APPARATUS FOR CONSERVING HEAT.—L'Office Central de Chauffe Rationelle, which is a company receiving a subsidy from the French Government, is arranging to hold in April next an international exhibition of all kinds of apparatus and materials designed or intended for the recuperation and conservation of heat. The exhibition will be on somewhat the same lines as the exhibition held in March of last yea., which dealt with apparatus for the control of heat, and which was a conspicuous success, but its scope will be considerably extended. It will be divided into two sections:—I., Lagging, insulating materials and refractories, and II., recuperators, regenerators, economisers and air re-heaters. Further particulars can be obtained on application to Monsieur L'Ingénieur Directeur de l'Office Central de Chauffe Rationelle, 5, Rue Michel-Auge, Paris XVIe.

Co-operation of the Engineer and Chemist.*

By G. M. GILL, of London, Member.

A GREAT need exists to-day for the supply of materials which have some pretence of being standardised, with quality, size and general characteristics much more uniform than is frequently the case with most manufactured commodities. With such variations in raw and other materials used for manufacturing purposes, it becomes a difficult problem to work plant and processes efficiently, and in such a way as to produce articles of standard quality and quantity. As a result, great loss is caused to the country's trade and industry generally.

It is proposed in this paper to deal specifically with coal and refractory materials, and to outline a system which has been applied with the object of standardising the quality of gas. The South Metropolitan Gas Company, being a user of coal to the extent of 1¼ million tons per annum, has found it desirable to establish a fully equipped laboratory and inspecting staff at Newcastle-on-Tyne for the purpose of examining coals supplied to the company. The coal is sampled as it is loaded into the company's ships, after which the samples are analysed, and all coal above a definite size is hand-picked free from dirt, the results being telegraphed to London in time to give those responsible for the operation of the works an opportunity of regulating the carbonising plant to suit the varying grades of coal before their arrival. This system is still in its infancy, but excellent results are anticipated, not only from the point of view of better informed buying, but also of improvement in the cleaning of coals, and in the working of plant to suit each consignment of coal. One of this company's stations has already instituted a system of carbonising by which automatic adjustments are made, varying with the volatile content in each consignment of coal.

In gasworks generally, the class of coal in use is varying in some cases from hour to hour, and in others from day to day, and as consignments of coal differ so largely it is not customary to alter the regulation of plant until some time after a fresh class of coal has been in use and its effect has become apparent to those in charge. This change is generally too late for full advantage to be taken of the characteristics of the coal, but if this could be done before a commencement is made on a fresh class of coal, much benefit would be derived. At present the name of a coal is the only indication of its characteristics, but coals vary so largely that the name is little indication of its quality. Coal is everywhere bought not by quality, but by name, and its price varies with the general reputation of the name in question, but there is so wide a variation in the quality of each coal that the worst cargoes of a so-called first-class coal are inferior to the best of a second-class coal. There is, in fact, a large element of chance in regard to the quality of any particular consignment.

The author would suggest that the time has arrived when each colliery should grade or classify the coals from the various pits and seams, keeping each grade of the same quality within the narrowest practical limits. The advantages of such a step to the users would be very great, and this would react favourably upon the whole coal industry. To a gas undertaking it would result in higher yields of gas and products per ton of coal and per unit of plant, a higher output per man and a smaller variation in the quality of gas made, and these would have the effect of reducing the price of gas. The desired improvement would be much nearer achievement if the coal were picked more efficiently and consistently, though, of course, this is not the whole of the problem.

In examining the samples of coals, they are screened through a sieve with holes ¼in. square, and the coarse portion not passing through is hand-picked free from dirt. A study of the results makes it quite clear that the picking process at the pits is a haphazard one, varying possibly in efficiency with the dates of the football matches in the district. The presence of this superfluous dirt in the coal causes untold loss in a gasworks. There is not only the fact that the buyer is receiving dirt instead of coal, but the dirt is transferred to the coke which is used in the furnaces for heating the retorts in which the coal is carbonised. In practice, the heating of the retorts is very greatly affected by the amount of dirt in the coke, and as a consequence its presence in the original coal is most objectionable.

The author would suggest that in the working of a colliery continuous sampling of the coal as it reaches the surface should be the daily and nightly duty of chemists, who would test the coal both physically and chemically, supplying the superintendent in charge with complete records of the quality of the coal, by which system the quality could readily be standardised within limits, varying with the consistency of the particular seams. The working of such a system would entail the employment of chemists in the collieries to a much greater extent than is now the case, and this would lead to the production of a better and more uniform quality of coal.

The effect of such improvement would undoubtedly be far-reaching, and while the author holds no brief for chemists, he is strongly of opinion that their presence at the engineer's side is essential to the proper conduct of industries generally, and here in the working of collieries is clearly fine scope for mutual co-operation between the members of the two professions.

REFRACTORIES.

The variation in size and quality of fire-bricks and blocks and retorts is one of the most unsatisfactory features with which users of refractories have to contend. All kinds of difficult problems have to be faced for want of uniformity in this respect. The table in the next column shows the varying dimensions of fire-bricks supplied by two well-known makers in this country.

Such variations are typical of material supplied by most of the fire-brick makers in this country, and the author has no hesitation in asserting that it is high time that fire-brick makers started to employ rational methods in the control of the ingredients used in brickmaking, and of their mixing, drying and burning. The variation in size is doubtless due to faults in one or other of these parts of the process, such faults being allowed to develop in the course of manufacture owing to a complete absence in most fire-brick works of any semblance of scientific control.

Maximum and Minimum Dimensions Found by Examining Twenty-four Fire-bricks—of each of two well-known makers—chosen at random from a stack of such bricks. The correct dimensions should be 9in. by 4.5in. by 3in.

	Length. Inches.	Breadth. Inches.	Thickness. Inches.
Maker (*a*)—			
Maximum ..	9.30	4.56	3.16
Minimum ..	9.01	4.40	2.90
Difference ..	0.29	0.16	0.26
Maker (*b*)—			
Maximum ..	9.35	4.5	3.12
Minimum ..	8.92	4.27	2.87
Difference ..	0.43	0.23	0.25

In visiting a fire-brick works, one is usually told that the important work of controlling the kilns is left in the hands of a workman upon whose judgment, without the aid of instruments, depends the degree and uniformity of the temperature and the period over which it is extended. The same is true of the choice of mixing of the raw materials from which the bricks are made. To anyone accustomed to the aid which is given by chemists and others whose duties consist of keeping a regular check upon all the factors which contribute to the maintenance of uniformity in the quality of manufactured commodities, it is, of course, obvious that the absence of this absolutely necessary assistance can but result in the defects of which mention has been made.

In the building of any structure of refractory materials, it is highly important that the joints between bricks and blocks should be as thin as possible, the bricks being "buttered" only, and consequently it is all-important that the thickness of such bricks should be uniform, as otherwise the bricklayer must either sort over all the bricks to get those of a similar thickness to lay in one course or he must increase the thickness of the joint wherever the thin bricks are laid. In either case the remedy is very objectionable. Here again there is scope for the chemist to work in conjunction with the engineer or manufacturer.

What appears to the author to be necessary in the conduct of fire-brick works is the institution of methods providing for (1) the continuous sampling and analysis of mixtures in use, both chemical and physical; (2) the use of heat recorders in kilns; (3) definite limiting standards for size and shape; (4) guaranteed working to specifications.

It might be argued that the extra cost of applying such methods would not be forthcoming from the sale of the materials made, or, in other words, that the bricks would be too expensive to sell. It is suggested that the contrary result would be experienced.

The control proposed would doubtless result in the production of a higher and more consistent quality of brick. This would increase sales and, consequently, lower overhead charges in the works. The control would further diminish rejected bricks, save fuel costs in kilns, increase capacity of plant and effect improvements which would result from increased knowledge of the process. At present, the most enlightened refractory users are searching the country for a better quality of materials, which is of far greater importance than that of price, important though that be.

Refractory users are hopeful, though not confident, that they may find what they require in this country. They do not want to go abroad for their materials, and if this course has to be taken it will be because they have been driven to it by the apathy of the British refractory manufacturer.

* Abstract of paper read at a joint meeting of the Institution of Mechanical Engineers with the Society of Chemical Industry, January 6th, 1922.

PRESENTATION TO A RETIRING CITY ENGINEER.—A framed copy of the resolution which the Nottingham City Council passed last October in recognition of the forty years' service of Mr. Arthur Brown, who retired last year from the post of city engineer, after holding that position for forty years, was presented to Mr. Brown at the meeting of the Council on the 9th inst. In making the presentation, the Mayor recalled the facts that at the age of twenty-three Mr. Brown became deputy borough engineer, and that six years later he was made chief engineer. During his term of office very many important works had been carried out, including the Trent Embankment, four miles of boulevards, the tramway schemes, the improvement of the cattle market, &c. Mr. Brown has now become consulting engineer to the Corporation.

CATALOGUES FOR BAGHDAD.—Information has been received in the Department of Overseas Trade that the Director of the Public Works Department, Baghdad, Iraq, is anxious to obtain catalogues, designs, specifications, prices, &c., of the following machinery and equipment:—Farm tractors, road tractors and agricultural machinery; excavating machinery; irrigating pumps; piping and pipe fixtures; well boring plant and casings; steel bridges, ready for erection; cement and concrete mixers; quarry plant; brick and tile-making machinery; portable lime kiln, using crude oil fuel; woodworking machinery; electric lighting and power plant; pumping plants; motor cars, lorries and tank wagons; petrol and oil tanks with measuring gauges; portable wooden houses with double roofs and walls; water craft; railway locomotives; aerial ropeways; refrigerating apparatus; and small electric lighting sets, with fans and accessories.

THE SUPPLY OF WATER TO MOTOR WAGONS.—In connection with the scheme now being drawn up by the conjoint committee of representatives of the British Waterworks Association and Associations of Motor Users and Manufacturers for the introduction of a universal fitting for the supply of water to motor wagons, a premium of twenty-five guineas is offered for the selected design for a lock mechanism, to be operated by a key in combination with a token, which can be applied to a cast iron service box of either of two specified types. The premium will be awarded under the following general conditions:—(1) The design adopted shall become the absolute property of the British Waterworks Association; (2) in the event of no design being submitted which, in the opinion of the Committee, shall be suitable for the required purpose, the premium will be withheld; (3) the decision of the Conjoint Committee shall be final and binding upon all parties; and (4) all designs, including any drawings or models that may be submitted, shall be sent to the secretary of the British Waterworks Association, Metropolitan Water Board offices, 173, Rosebery-avenue, London, E.C. 1, not later than 12 noon on February 14th, 1922, from whom further particulars and drawings of the service boxes may be obtained.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

January Quarter Day.

THE present week has seen the Midland iron trade January quarter day. The exact event was to-day (Thursday), but the whole week more or less has been a quarter day affair. The market has been largely attended, many traders, including merchants, being present from the kingdom's other iron and steel making districts, but no large tonnage of business has changed hands. It is calculated, however, that if the new quarter should bring an improved trade one of the first effects would be a stiffening of pig iron prices, inasmuch as they are now below the cost of production. Some deals have been made by merchants who want to cover against contingencies. This I may definitely record is the first sympton of the kind that has shown itself for a long time. Merchants' dealing in finished iron and steel are on the whole hopeful, large Birmingham houses having received quite encouraging country orders from warehouses having very low stocks, while in one or two instances orders were reported to be better from South Africa, Australia and India. Concerning the state of activity in the district it has still to be noted that production has scarcely recommenced in the manufactured iron and steel trades, only a few mills here and there being in operation. One explanation of this is the fact that foreign business has hardly had time to materialise after the holidays. There are more inquiries for supplies, but prospective buyers hesitate to come to close quarters. Current business is still on hand-to-mouth lines. Continental competition is not such a dominating factor in the market. For many classes of iron and steel the prices ruling in the district are now lower than those which Belgian and German manufacturers can afford to quote. Certain materials can still be bought abroad at rates which make our own look extravagant, but the buyer has to take delivery when he can get it, and this uncertainty is a deterrent to business. Transport questions are still much discussed, and there is no doubt we shall hear a great deal about railway problems in the coming months. Manufacturers are not at all satisfied with the recent concessions, and will undoubtedly press for more.

Irregular Bar Iron Prices.

The outstanding feature of the January quarterly meeting has unquestionably been the acute irregularity of prices in the unmarked or merchant manufactured iron trade. I have recorded in this letter for several weeks past the increasing rift in the Staffordshire bar makers' lute, and the width of the hurt has now become great. The nominal standard of £13 has for weeks past exhibited any number of downward graduations until the pianissimo has now been touched at £12 and £12 5s. per ton. The underselling is not only in this district, but more especially from Lancashire. The County Palatine has all along led the way in reductions, the view in that district being that, at whatever cost, rock-bottom level must be reached as quickly as possible. Some Birmingham merchants stated at the quarterly meeting here that they had received offers of Lancashire bar iron as low as £11 per ton. It is not pretended, however, that this material is equal to the recognised Staffordshire quality, being chiefly used for such purposes as fencing. An attempt to evolve order out of the existing chaos so far as Staffordshire is concerned was made in advance of quarter day in the shape of an important meeting of the bar iron makers. As already intimated, a vast amount of underselling has been in progress, and the question was debated whether another attempt should not be made to secure uniformity of action by a reduction in selling prices. Strange to say, however, the meeting decided against any reduction in view of the high cost of fuel and other elements entering into manufacture, including the increasingly vexed question of railway rates. The efficacy of an association which cannot control prices is naturally doubted by those who have entered it to secure stability, and there are a good many defections. It is becoming a question how long even a semblance of unity can be maintained. The official declaration of £13 has very little practical application. Unassociated mills accept from 10s. to 15s. less and, as I have already intimated, some firms openly quote as low as £12. Even at these low figures it was announced at the quarterly meeting that there is so little business to be had that some of the associated firms doubt the wisdom of entering into a cut-throat competition for it. Others feel, however, that future trade is at stake, and that they ought not to be tied to a price which has no practical application. Belgian bars are firming up again after their recent relapse, but they can be bought at £9 15s. delivered here. The circumstances of the market are against an expansion of business with the Continet, however. Another feature which has become more prominent in the bar iron trade, as well as some steel branches, is the disregard of standard extras. Many sellers are exercising a free hand in this as in other matters. Staffordshire marked bars are re-declared at £16 per ton.

Pig Iron.

Only very small lots of pig iron changed hands at the Birmingham quarterly meeting. Some houses stuck to their old quotations, but more generally sellers acquiesced in a drop of about half-a-crown as compared with the old year's figures. There has been a break in coke prices. The position is rather equivocal, but business could be done at 20s., against the official price of 22s. 6d. which has been ruling. Confidence has been so badly shaken in the raw iron trade, however, that consumers will need to see more orders coming forward before they put their idle blast-furnaces into operation. Some raw material has been sold for forward delivery, but these transactions are small. Blast-furnace owners want clearer indications of the expected new demand before they commit themselves. Purchases against visable require-

ments are evidently being held back to the last possible moment. Demand is so poor that some of the Derbyshire and Northamptonshire furnaces may be obliged to damp down shortly, while the re-starting of other furnaces is looked upon as out of the question for the time being, particularly in view of the high cost of transport. One large Derbyshire concern, which damped down two of its furnaces three weeks ago, has re-started one, though there is some doubt whether it will continue in operation. The very meagre concessions made by the railway companies have discouraged any expectation as to the re-lighting of other furnaces, and there were great complaints this week of the action of the railway companies. Prices were quoted: Northamptonshire forge £4. foundry £4 7s. 6d., Derbyshire forge £4 2s. 6d., No. 3 foundry £4 10s. and upwards at furnaces. A slight improvement has taken place in engineering, which encourages hope on the part of makers of foundry iron that better orders for this material may shortly be forthcoming. Stocks are much heavier than before the holidays. The official reduction in Cleveland prices is being much discussed here, and it is thought that Midland prices will fall accordingly.

Steel.

The rivalry between iron and steel has once more become acute, in view of the much lower prices of the latter material. Steel sheets and steel strip for tube making, as well as steel bars for the under frames of railway wagons, are being preferred on the ground of price, although the older metal has the reputation for greater durability. English wire rods can be bought at £11 10s. while Belgian range from £11 10s. to £11 15s. Imported finished steel bars are about the British price, viz., £10 for small sizes. Isolated quotations have been received this week for Belgian joists at £7 15s. Antwerp, which is well below English figures. But when non-compliance with British quality standard, and prompt cash payments are taken into consideration, these offers are not particularly attractive, especially as the English works can now give prompt delivery. The galvanised steel sheet trade is rather quiet, with prices easier at about £16 10s. per ton. While the feeling on the whole is hopeful, actual improvement materialises very slowly. Makers of mattress wire in Canada, the United States, and Germany are challenging the Midland and Lancashire mills, Germany in particular quoting very low prices as compared with those which have ruled here. Home makers now have replied by lowering their rates £3, leaving them at about £23 to £25 per ton.

American Steel Billets on Offer.

For the first time for something like two years, American billets are being sent on to the Midland market. They are offered at a price which may be tempting to consumers near the ports, but the extra cost of carriage to the Midlands puts them out of the field here. District quotations vary from £7 15s. to £8. A large Staffordshire firm has reduced its quotation for billets from £8 to £7 15s. The motive in this case does not appear to be foreign competition, but the keen rivalry of English firms for such business as is obtainable. While there are rumours of foreign offers of billets, the actual quotations obtained are usually very close to native prices, and in some cases are higher.

Restarting of North Staffordshire Ironworks.

There are indications of a slight revival in trade in North Staffordshire. On Monday the Etruria Mills, belonging to the Shelton Iron, Steel and Coal Company, the largest concern of its kind in the district, commenced work, and the Shelton mills of the same company are stated to be starting some time this week. These mills have been idle for some considerable time, and it is anticipated that they will employ about 2000 men. Many ironworkers in North Staffordshire have been continuously unemployed between forty and fifty weeks, and the re-opening of the mills will afford them some measure of relief.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel, and Metals.

THE general condition of the iron and metal markets is still depressed, and the prophecies of a revival of trade in the New Year are received on the market here with rather grim amusement. One of the major hindrances to business is that neither India nor the Argentine can sell produce satisfactorily, and hence they do not get the credits necessary to enable them to buy our goods. The engineering industry and the cotton trade are both suffering severely from this one cause, and there is no immediate prospect of relief.

Metals.

The dulness in the non-ferrous metal trade continues, and the markets are stagnant. There is very little change to note in the prices, but there seems to be a little better demand for copper. Germany, however, is still by far the biggest consumer of copper in Europe; and this is very far from being satisfactory. The outlook for copper is extremely uncertain, and much will depend upon whether or not America increases her production. It is said that a good many of the idle copper properties in that country will shortly be re-started, and if so there can be little doubt that the output will be increased beyond the present needs of the world. It is of course possible that some improvement will take place in the consumption here; but so far one sees little prospect of it. It does not seem probable that the prices of copper can fall very much now, but a return to higher prices is difficult, so long as the engineering trade is depressed, and so long as the productive capacity of the world is so much greater than its consumptive capacity. It is said that the American copper industry is now capable of producing twice as much metal as the world, in its present condition, can consume; so that a very big revival in industrial activity is wanted to bring about a proper relationship between supply and demand. The lower prices for yellow metal "braziers" and rods is something to the good, but what are wanted much more urgently are lower prices for copper and brass engineering tubes. Copper rods are now being quoted at £5 per ton above copper braziers, and yellow metal rods are quoted £16 6s. 8d. per ton below yellow metal braziers. In tin there has been no special movement, but the tendency to advance seems to have been checked for the present. Doubt has again arisen as to the policy of the Federated Malay States Government with regard to its stock of tin. There has certainly been some improvement in the demand, but it is counteracted by the larger sales from the East. Of course this may not mean that the Federated Malay States Government is liquidating its stocks. That is generally denied; but it is well known that more tin exists in stock than can be brought into consumption at present. Lead is quiet, and there is a slightly easier feeling in it; but the price remains fairly high. Spelter is quiet and without much change, but the tone is rather stronger, and many people seem to be expecting an upward movement.

Pig Iron.

The position here in the pig iron market is still extremely unsatisfactory. There is practically no demand worth speaking about unless it be for Scotch iron, which is being sold by "bear" houses at less than the makers' prices. The reason that business in Scotch iron is more active than in common iron is no doubt because the textile engineers are much better off for work than is the ordinary mechanical engineer. In talking with leading iron-founders one gets the idea that they are for the most part without new orders for castings, and that they are not thinking of buying foundry iron at present no matter what the price may be. A very small business is no doubt being done, but the aggregate does not keep what few furnaces there are at work fully occupied; and hence one must suppose that although the output of pig iron is only about one-fourth of the normal, it cannot all be sold. In these circumstances it seems likely that "bears" of pig iron are doing wisely to take what orders they can get without looking too closely at the price paid. There is a better feeling reported here from the Cleveland market. This, however, does not mean that higher prices are likely in the near future; but merely that the hope is growing of a better consumption. There is ample room for improvement in this respect, not only in Cleveland but throughout the whole world. The prices for foundry pig iron in this market are rather uncertain, and there are no large transactions by which to test them; but Midland makers do not yet see their way to quote below £5 per ton for Manchester delivery.

Finished Material.

In the market for sectional steel and finished iron practically nothing is stirring. The iron prices are, of course, far too high, but that is scarcely the case with the steel prices. Nevertheless, if there be any people able to buy steel at present it is evident that they are anticipating lower prices in the near future, and will postpone operations as long as possible. There is little competition here from foreign steel; but what there is is severe enough in our export markets.

Scrap.

There is, as yet, no movement in scrap. The reports that large quantities of steel scrap had been sold for export to Germany are now denied. In any case, if they are true, they have not yet stimulated the home market. Foundry scrap is neglected; but of course when there is no demand for foundry pig iron there cannot be much market for cast scrap.

Japanese Visit to Manchester.

This week the leaders of industry in Lancashire have had an opportunity of discussing trading and manufacturing conditions with the members of the Japanese Commercial Mission which is now on a visit to this country. On Monday these gentlemen were shown some of the sights of Manchester before being entertained by the Chamber of Commerce at luncheon, where some interesting speeches were made. The President of the Chamber, Sir Edwin Stockton, said that the world needed all the productive energy of Japan and Great Britain, and that there need be no cause for jealousy between the two nations, but only opportunities for friendly co-operation. In replying to this speech, Dr. Takuma Dan, who is the managing director of the Mitzui Bussan Kaisha, one of the largest trading corporations in the world, said that no sooner did a Japanese arrive in England than he wished to rush to Manchester. He said that while Japan was looking to Manchester for the best spinning machinery, Manchester might grudge Japan the progress she had made in supplying India and China with cotton goods, but that Manchester need not be apprehensive of serious competition on the part of Japan. The cheap Japanese labour spoken of in this country was said to be a serious danger to Lancashire's textile industry, but, he said, without a certain standard of efficiency cheap labour could not help Japan. Even if they had cheap labour—which they now had not—the recruiting of labour for the cotton industry was anything but an easy matter. Labour had to be recruited from season to season from agricultural districts, and the operatives—especially the women—were sooner or later called back to their homes to domestic duties. He said that wages were 200 per cent. higher than before the war, and in many instances mills and factories had been built in inconvenient places. English supremacy had been obtained by supplying goods of high quality, and Japanese manufacturers agreed that they could not compete with us in first-class goods. The chief market for Japanese goods, he added, was China, and sooner or later that country with her abundance of cheap labour would become the competitor of Great Britain and Japan. During a discussion later in the day, the subject of tariffs was referred to, and mention was made of the tariff imposed by Japan in 1911 on foreign goods. Mr. Chokiuro Kadono considered that Japan had been moderate in the application of tariffs, as she had not built walls that British manufacturers could not climb. He hoped that Japan would not go beyond a moderate, revenue-producing tariff, but manufacturers of iron and steel wanted higher tariffs.

Wireless Telegraphy in the Mercantile Marine.

An interesting and comprehensive paper on "Wireless Telegraphy in the Mercantile Marine" was read before the Liverpool Engineering Society on Wednesday last by Captain J. A. Slee. The subject was subdivided into seven sections, as follows:—(1) General aspect; (2) types of apparatus available for spark transmission; (3) types of apparatus for continuous wave transmission; (4) receiving instruments; (5) direction finding; (6) automatic devices; and (7) wireless telephony in ships. Captain Slee said that receiving instruments had been improved almost out of recognition during and since the war by the introduction of amplifying devices, and that effective ranges were twice as long as were possible in pre-war days. As regarded transmission, an arc transmitting set well designed and installed and equipped with a distance operated starter for starting the arc formed an exceedingly effective continuous wave transmitter for merchant ship purposes. Its electrical disadvantage was that it required a good deal of clearing out and adjustment, and its commercial disadvantage was that the efficiency from direct-current energy to aerial-current energy could not exceed 30 per cent. Technical difficulties in reproducing human speech by "wireless" had been overcome, but the problem of application to ship working remained to be solved.

BARROW-IN-FURNESS, Thursday.

Hematites.

There has been a renewal of activity in the hematite pig iron trade in North Lancashire. Just before Christmas two furnaces were damped down at Barrow, owing to the quietness of trade and the inability of smelters to keep their smelting plant at work during the holidays. Now these two furnaces are again operating. A good proportion of the iron is going into prompt use at the firm's own steel works. It is expected that in other parts of the district furnaces will shortly be at work. The feeling in the trade has improved, and prospects are considered better than they have been for a long time, and the opinion is expected that buyers will now come forward more readily with their business, seeing that prices are at about the minimum for the time being. A general resumption of activity, however, cannot be looked for for some time.

Iron Ore.

There is now a better demand for iron ore, and at some of the North Lancashire pits operations have been resumed, mostly on short time. Some of the mines remain closed down, only pumping operations being carried out. The importations of Spanish ore continue.

Steel.

On Monday there was a resumption of activity in the steel trade. The melting departments at the Barrow works were engaged, and on the following day the rail mill, steel foundries, &c., were restarted. Hoops are again being rolled. There is only a quiet demand for all classes of steel.

Shipbuilding and Engineering.

These trades are again at work, but there is a marked shortness of orders, and less men are employed than for many years past. Vickers Limited will launch the steamer Jervis Bay, the third of the Commonwealth Line, on Tuesday, January 17th. It is reported that the firm has received an order for the Diesel engines for a mine layer, the hull of which is to be built in one of the Royal dockyards.

SHEFFIELD.

(From our own Correspondent.)

A Little More Hopeful.

IN these days one clutches at any straw which seems to indicate a turn in the tide. Thus a report that one of the biggest of our east-end works had re-started its electric furnaces and was preparing to follow suit with the Siemens furnaces sent me hurrying down to investigate. I found the report was not without foundation, but at the same time of no special significance. What had happened was that this concern had made one of its periodic re-starts, such as have been a fairly common experience during the whole of the slump period. Orders have been allowed to accumulate until there has been a sufficient bulk to warrant the re-starting of the furnaces, and then these orders have been worked off and both furnaces and men been allowed another period of unwanted "recuperation." Whether the present spell of renewed activity will be supplemented by further fresh orders remains to be seen. There is, however, a distinctly more hopeful feeling among the heads and the responsible officials of the big firms "down east." It is difficult to point to any concrete fact on which to base this confidence, but it certainly exists. Just now there is a good deal of curiosity concerning the intentions of the railway managements as to the disposal of the nice little New Year's gift the companies are receiving in the shape of Government compensation—amounting in the aggregate to about £24,000,000. Sheffield firms are hoping that this will not all be distributed in dividends, but that a considerable portion of it will be spent on repairs and renewals. In this case, of course, Sheffield will be one of the first and principal beneficiaries. At the same time it is not wise to place too much reliance on these expectations because the Railway Boards will naturally postpone any considerable expenditure upon repairs and renewals until the grouping scheme is finally in operation, as under this there may be effected con-

siderable economies in the matter of rolling stock and engines. Indeed, such savings are an essential feature of the grouping scheme, and it is scarcely likely therefore that any lavish expenditure can be looked for at present. This may not be particularly palatable news for Sheffield, but nothing is to be gained by holding out hopes unlikely to be fulfilled. Then, it must be remembered, that there are no great electrification schemes at present before the country. Even the public inquiry on the Sheffield Corporation supply scheme for the North Midlands area, for which the Electricity Commissioners had fixed a day, has been deferred, and the date of the adjourned inquiry has not yet been announced. For this, as for all other big undertakings—and of course the same observation applies to smaller jobs—the great obstacle is cost. "What we want is to get back to 1914 prices," was the final comment of a gentleman with whom I was discussing the general position: and he added, with quiet confidence, "there is a distinct tendency in that direction."

The Coal Position.

The price of coal is of course a prime factor and it is satisfactory to note a slightly easier tendency in this connection. Since the holiday interruption the demand for industrial fuel has not been so active, many of the works having resumed operations only this week. The export of steam coal is also inclined to be on the small side. There are plenty of inquiries in the market for forward quotations, but orders are being placed very slowly. Prices are undoubtedly tending in the downward direction and buyers would be well advised to remain on the open market. Wages will come down and prices to consumers will be correspondingly reduced. Quotations are merely approximate. In some cases collieries are asking substantially higher rates, while in others—for special sales of stock—considerably lower prices are accepted. particularly where any weight can be dealt with. The demand for gas fuels is not nearly so strong as it was before the holidays. This is, no doubt, due in large measure to the fact that now that the year has turned works are more disposed to draw on their very heavy reserves, especially in view of the expected price reductions that will obtain in the near future. So far as the market for small fuels is concerned it must be admitted that the recently increased productions (owing to pits working better time) have augmented the supply to a greater extent than the market can absorb. There is a considerable amount of forced selling in evidence, and in many cases prices are quite a secondary consideration to that of clearing the heavy stocks that are at pits. Of course, the root of the trouble in this market is to be found in the comparatively small number of blast-furnaces that are in operation—compared with, say, September, 1920, when something over 300 furnaces were in blast throughout the country. Now the number is only slightly in excess of 80. Until a largely increased number of furnaces is put into full operation it is scarcely likely that the demand for small fuel will be sufficient to take up the tonnage that is now on offer on the market. For the time being production of blast-furnace coke is greater than the actual requirements for inland purposes, and although. up to a short time ago, the surplus was readily taken up for export this business has fallen off very considerably, resulting in a great amount of competition for inland business. Prices are consequently on the lower side, although quotations in many cases remain officially unchanged.

More Colliery Development.

Progress in connection with the development of the South Yorkshire coalfield which was interrupted by the war has lately been resumed, and as soon as the industrial demand for coal warrants it, some of the new pits will be able to show a very creditable output. The Hatfield Main Colliery, near Doncaster, for instance, has a plant designed for a daily yield of 4000 tons. The new winding plant has just been completed. The downcast shaft, which is the main coal-drawing shaft, has been sunk to the Barnsley seam, a distance of 820 yards. The winding engine of this shaft has been made by John Musgrove and Sons, and is the largest the firm has ever built. The drum is spiro-cylindrical, and weighs 108 tons. while its shaft weighs 32 tons. Its cylinders have each a diameter of 42in., with a stroke of 7ft. The engine has an indicated horse-power of 1900 horse-power, and the wind is accomplished in 50 sec., a speed of over 30 miles per hour. The "Whitmore" safety overwind apparatus is installed. The winding rope is 2¼in. diameter, is of the lock-coil pattern and has a breaking strength of 290 tons. The headstock has been built by Taylor Brothers, of Goldburn, Lancashire. It is a steel structure standing 104ft. above its concrete foundations. The pulley wheels measure from flange to flange 21ft., and weigh 10 tons. There are eight conducting or guide ropes and two rubbing ropes, each rope weighing 10 tons. They are kept taut by means of weights, ranging between 5 and 6 tons. The double-decked cages carry 6 tons of coal at each wind. and each deck will accommodate forty men. Exclusive of house and foundations, the engine cost £27,000 and the headstock £16.000. The No. 2 shaft is slightly smaller in every detail. The engine was built by Robey and Co. at a cost of £21.000. The headstock, erected by the colliery company, is a concrete structure on the Kahn principle, containing only 30 per cent. of steel in the structure—which, it is of interest to note, is only the third of its kind in the country, one of the others being at Bentley, only a few miles distant. Housing accommodation is one of the difficulties confronting the management, but by the end of the present month it is hoped that the colliery will be yielding something like 1000 tons per day. The next development will be the erection of the permanent screens, and with the completion of these the output will be greatly increased.

Cutlery Conditions.

The coroner's inquiry into the circumstances under which four employees lost their lives at the recent fire in one of the small and old-fashioned shops in which the Sheffield cutlery industry is carried on, again directed attention to the dangers attendant on the conditions which therein prevail. The works in question were erected seventy years ago, but have, of course, been from time to time inspected, and the precautions were considered adequate. But it is a sad coincidence that since the opening of the inquest the new Home Office regulations concerning the use of celluloid in industry, which have been under consideration by the Home Office for many months past, have been published in the *London Gazette*. These regulations, the coroner said, dealt with every point upon which the jury might have thought it wise to add a rider to the verdict. Under these regulations the conditions which existed at the works would have been avoided. The most probable cause of the fire, as suggested by the fire brigade officers, after a very lengthy investigation, was that a spark from an emery wheel fell on celluloid dust. The conditions at these particular works are by no means exceptional. There are a great number of small cutlery shops, carried on by "little mesters," as they are known locally, in which the precautions against fire and provision for escape are not good. These shops are the surprise of every stranger visiting the city who is taken on the customary tour of inspection. The cramped conditions under which the industry is carried on are not only a menace to the health and safety of those engaged therein, but make it little less than miraculous that under such a handicap Sheffield should have retained its supremacy as the cutlery capital. There are, of course, a few modern establishments which furnish a pleasant contrast, notably those at which mass production methods have been introduced. Foremost among these is, of course, the Sheffield Steel Products Company's big factory at Templeborough. Another is the admirably laid-out factory at Attercliffe erected during the war by Edward Dubied and Co., Limited, for the making of fuses. There is now installed there a plant of automatic machines which the director, Mr. J. Stuart King, claims is unique of its kind in this country; certainly Sheffield has nothing like it At present it is producing non-skid studs for motor tires at the rate of two millions per week, and spindles, cones and nipples and other motor cycle and cycle parts in enormous quantities. Fifteen machines are available for the manufacture of rivets for use in agricultural and similar tools, each with a capacity of 25,000 per day. Small screws, bolts and nuts for the Sheffield edge tool industry are turned out at the rate of about 50.000 per week—a trade captured from America within the last year. Another machine will roll the thread on bolts at the rate of 20,000 bolts a day, and a companion machine is busy tapping nuts at the rate of 15,000 daily. Bumpers and presses for punching out washers and blanks for the Sheffield cutlery trade are not working up to their production capacity, because Mr. King has found a strange reluctance on the part of those engaged in this industry to take advantage of the modern machines he has installed. and which he has demonstrated can produce cheaply and efficiently many of the small "repetition" parts which in the majority of shops here are still turned out tediously by hand. A recent development has been the safety razor, which can now be produced at a price competitive even with the German article, and with very much finer finish and in seven distinct designs. There is no doubt that conservative manufacturers will be compelled to come into line and investigate with less distrust the capabilities of the remarkable machine tools which can add so enormously to the resources of the factories. The cutlery trade is at present at the beginning of this transformation, but the old traditions and practices die hard. Meantime, the trade is greatly delighted with the protection granted by the United States Federal Trade Commission to the name "Sheffield," the judgment establishing the recognition that in the cutlery trade there is only one "Sheffield." Such protection will not, however, permanently save the trade in face of the increasing menace of machine production to which rivals are resorting.

New Developments.

The formation of Industrial Steels, Limited, as an offshoot of the old-established firm of Jonas and Colver, Limited, is an interesting development in the steel trade of the city. The parent company will continue and retain its business at the Continental Steel Works. and the new company will continue the business previously carried on at the Novo Works, the declared policy being to manufacture steel consistent with the lowest cost. No public issue of capital is at present arranged for. The parent company has made extraordinary progress during its fifty years' existence. Commencing with a staff of fifteen, to-day, under normal conditions 2100 would be employed. The works of the two companies cover 25 acres. Sheffield has for years past been waiting with more or less patience the long-promised automatic telephone exchange. For two years past the Post Office cable-laying plans have contemplated the erection of this new exchange. It is to be a handsome building four stories high. It is now announced that the plans have been completed, and that the Office of Works is inviting tenders immediately, and that the contract will be placed as soon as these tenders have been considered. It is estimated, however, that at least a couple of years will be occupied in completing the installation.

NORTH OF ENGLAND.

From our own Correspondent.)

The Outlook for Trade.

A CAREFUL examination of the industrial situation in the North of England justifies the belief that the corner of depression has been turned at last, and that life is being gradually restored to industry. There is not, however, likely to be any sudden transition from depression to prosperity. Trade inquiries are certainly improving. and leaders of industry are looking with confidence to a progressive improvement. But some considerable time must elapse before matters reach anything like a normal level. The road is still likely to be a rough one. but manufacturers are facing the situation boldly and determinedly, which is a happy augury for their success. The iron and steel trades have passed through a most difficult crisis, but prices are now nearing a competitive level. and the opinion is strong that the next few months will witness the long looked for revival.

Cleveland Iron Prices Reduced.

Recognising that lower prices are vital to a recovery of the iron trade, the Cleveland ironmasters this week decided upoa an all-round cut in the official prices. The reductions decided upon are 10s. per ton in the case of No. 1 and No. 3 Cleveland foundry iron, and 7s. 6d. per ton off No. 4 foundry and No. 4 forge. The new quotations are as follows:—No. 1 and siliceous iron, 95s.; No. 3 G.M.B., 90s.; No. 4 foundry, 87s. 6d.; and No. 4 forge. 82s. 6d. Mottled and white iron are nominally at 80s., but there is a free market in these qualities, and the prices might be cut, whereas for all other Cleveland qualities the official prices are the makers' minimum. The reductions are pretty much in accordance with expectations, and there are now hopes of such an expansion of business as will permit of the re-starting of a few more idle furnaces. Buyers have been very cautious, and in many cases have refused to do business under the promise that they should have the benefit of any fall in prices. They have preferred to wait for the reductions to become operative. There has, however, been much more inquiry of late, and traders are confident that business will now open out. They are looking forward to a substantial business with Scotland. It is now possible to send iron to Scotland coastwise at about 10s. per ton, and at round about 100s. per ton delivered it is believed that there will be a good demand in Scotland for Cleveland foundry iron, especially as supplies from the Continent seem to be lessening. There is, moreover, more inquiry from abroad, and whilst contracts have in most cases to be concluded the prospects are distinctly more encouraging.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade is decidedly more encouraging. The cheapness of the local product as compared with other areas is attracting attention from a wider area and some fairly good sales have been made during the last few days. South Wales continues to take considerable quantities, and Italian consumers, notwithstanding the difficulties of finance, have bought fairly heavily. Still the trend of prices is downward, and an average price for East Coast mixed numbers is now no more than 97s. 6d., with No. 1 at 100s.

Iron-making Materials.

The foreign ore trade, which has been stagnant for some considerable time past, is showing signs of activity. There has been better business in ore from Mediterranean ports. These ores are relatively cheap, and as the freight is much lower than the Bilbao freight, buyers are attracted by the more favourable terms. Best Rubio ore is, however, also in slightly better demand, and sellers put the price at 26s. 6d. per ton c.i.f., though a buyers' figure is no more than 26s. Coke, too, is cheaper as a consequence of the fall in railway rates, and good furnace qualities are now offered at 27s. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade shows little signs of improvement. Many of the works are still idle, and others are merely operating from hand to mouth. Few orders are being placed. Possibly buyers are awaiting another fall in prices, but on that subject no decision has yet been reached by the steelmakers.

The Coal Trade.

The Northern coal trade situation has become somewhat difficult and involved by reason of the complete dislocation of the loading turns and the absence of expected tonnage, which is due to recent storms. This has had the effect of rendering the efforts of coal fitters most difficult and occasioning lost time at the pits inevitable. The market generally is fairly steady for prompt, though supplies are available for early shipment at a discount occasionally, when a spot boat is in hand. The forward market is not improving to any appreciable extent by reason of the fact that buyers are either not in a position to commit clients abroad for lack of definite instructions, or more often, are playing a "waiting game" in the expectation that present prices cannot be sustained for any length of time. The prospects for a heavy trade with Italy, France, Denmark, Norway, and Sweden are said to be fairly bright, judged by the inquiries and "feelers" constantly in the hands of exporters, but so far the volume of trade actually booked is only small. At the same time the majority of buyers continue to buy very cautiously, while even collieries are not always too well disposed to commit themselves very far ahead, which indicates most clearly the lack of certainty and assurance as to future values, and renders heavy booking too risky to undertake. The Northumberland pits are fairly well off for trade for this month, their bookings being moderately heavy, and the full quotations are being adhered to, which applies to second grades as well as best screened. In the case of smalls it is possible to purchase rather more cheaply than a little while ago. The Durham position is patchy. There are supplies available, more especially as tonnage is temporarily scarce, though with improved weather the position will be gradually relieved. There is no improvement in the coke market, which is generally flat and void of movement.

Realised Price of Cleveland Iron.

The ascertainment issued this week by the Cleveland Ironmasters Association shows that the average net selling price of No. 3 Cleveland pig iron for the last quarter of 1921 was £5 11s. 2.15d. per ton. The price for the third quarter of 1921 was £6 11s. 5.13d., a reduction having occurred during the quarter to the extent of £1 0s. 2.98d. The price just issued, however, will not affect blast-furnacemen's wages, a special arrangement having already been come to between the Cleveland ironmasters and the blast-furnacemen's representatives under which the district percentage will be reduced from 77½ to 36 above the standard.

Cleveland Miners' Wages and Hours.

In accordance with the usual formula of settlement under the sliding scale based on the ascertained sell-

ing prices of pig iron, Cleveland miners' wages have been reduced by 25.3 per cent. upon the base rate. The wages thus drop from 129.2 to 103.9 per cent. above the base rate. The mine owners are pressing for a lengthening of the working hours both of underground and surface workers. At present, in the mines, a seven-hour day is in operation, and as this includes the time occupied in getting in and out, the total amount of time spent in the mine averages about 7½ hours per day. The question has been postponed for three months, and the employers have intimated that they will then bring forward a proposal for the establishment of an eight-hour day for the miners and a 49-hour week for surface-workers, as against 46½ hours now worked by the latter. As an alternative they will press for a reduction in wages equivalent to the payment for the extra hours which they desire the men to work.

SCOTLAND.

(From our own Correspondent.)

Quiet Markets.

THE holiday spirit continued in evidence during the past week, and business in all industries was of a very quiet nature. Markets therefore were very dull, neither buyers nor sellers showing any inclination to operate until conditions are more settled. The long spell of industrial slackness has led to a prolongation of the holidays, and some time must yet elapse before anything happens calculated to show the trend of affairs. The coal trade is likely to make a pretty good re-start during the present week, but any movement in the steel and iron industries will probably be of small dimensions for some time yet unless unforeseen circumstances arise.

Decrease in Shipbuilding.

High costs of production and labour troubles have had their effect on the shipbuilding as well as on other industries, and the year 1921, which otherwise might have closely approached record, was most disappointing, considering the promise shown in the first two or three months. The slump in the cost of second-hand tonnage and falling freights were serious considerations for prospective owners, and many new steamers were cancelled. Then the strike of shipyard joiners led to further cancellations and also to the deflection of steamers to other districts or to foreign yards for completion. New orders were almost entirely lacking, and with the launching of ships empty berths increased. The settlement of the joiners' strike and considerable reductions in costs have put a better complexion on the situation, and there are rumours of busier times ahead. In the Clyde area it is hoped that orders of a substantial nature will be forthcoming to take the place of the cancelled Admiralty contracts. The loss of that work meant a serious increase in unemployment at the shipyards and steel works in the district, the loss in wages alone amounting to many thousands of pounds per week. Towards the end of the year work was resumed on a number of vessels principally of the passenger type, and a fair number of workers regained employment. Thousands, however, are still out of work. The returns for 1921 for the Clyde area amounted to 249 vessels of 511,185 tons aggregate, compared with 330 of 672,438 tons aggregate in 1920.

Steel and Iron.

So far as regards the Scotch steel and iron trades, the year has had a very quiet opening. Business has been of an extremely quiet nature and nothing of importance has gone through. The refusal of the Scottish railway companies to re-consider their attitude towards costs of transport has only deepened the depression in trade circles. In view of the charges imposed for transit in Scotland, it is felt that local producers have little or no chance of competing with manufacturers over the border, and that until easier terms are forthcoming it is useless to expect any improvement in the steel or iron position. English makers are able to undercut Scotch works for delivery in the Clyde area, and if the latter cannot compete for local business, unless at an unbearable loss, they are not likely to have any chance further afield. Nevertheless, it is said that the demand for both black sheets and bar iron is improving and that the position of pig iron is somewhat better. Until the works are re-started and markets show more signs of serious business it is impossible to ascertain the actual trend of affairs. The only thing that seems certain is that prices will take a further step downward.

Coal.

Though the Scotch coal trade has been comparatively quiet during the past week, employment has been fairly good. Export in all districts has been delayed by the holidays and also a few days of rough weather, but the inquiry is well maintained and business will soon be as brisk as before the stoppage for the new year holidays. Trade is still of a one-sided nature. The land sale department shows little movement and is not likely to improve until some change comes over the industrial situation. Shipments for the past week amounted to 78,544 tons, against 264,001 in the preceding week and 61,272 tons in the same week last year.

Reduction in Wages.

The wages of miners in Scotland are now subject to a reduction of about 2d. per day.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE volume of export business being arranged on the coal market can scarcely be described as active, and it is certainly the case that the improvement that was noticed at the end of last year is not being maintained. Expectations are not being fulfied, but prices are not weakening appreciably, for the reason that owners are doing their utmost to stiffen their backs. The position is that this is a case of necessity, for so many collieries are losing money that the line must be drawn somewhere, and they must make up their mind whether it is policy to go on working at a greater loss or suspend operations. Very little definite news has been recently heard concerning contract business over the current year, and the only rumours in circulation have been with regard to Indian and Far East inquiries. These are to the effect that three firms have contracted to supply coals, the quantities mentioned being 100,000 tons in the case of two of them, and 150,000 tons in the case of the other.

Labour Situation.

Last week the miners' leaders on the Conciliation Board put their case before the employers, when the latter were informed that unless steps were taken to remedy the existing evils the workmen would do so, and that unless an improvement took place a stoppage of work was inevitable. The men submitted that the wages of the miners were below the level of subsistence, and that the chief cause of the low prices and the reduced revenue was needless competition in the sale of coal. It was contended that this price-cutting could be removed by proper organisation and the adoption of a different policy regarding the sale of coal. The owners' reply was very much on the lines expected and was non-committal so far as any promise to take action to meet the present situation was concerned, which is admitted on all hands to be a very serious one. No one for a moment thinks that the earnings of the miners are adequate, particularly in view of the short time now being worked in the coalfield, but the question is, Can the industry stand more in wages? The owners pointed that out the miners themselves were partly responsible for the conditions existing, and so far as prices of coal were concerned, it was only by successful competition that South Wales could recover its trade and provide employment. It was emphasised that there was still competition to be faced, and the continuance of threats to bring about either a partial or general stoppage would have disastrous results. So far as the finances of the industry are concerned, the men were informed that there was not even sufficient money to pay the minimum of 28 per cent. to the workmen during the present month. As a matter of fact, the audit shows that after making provision for the standard wages cost, other costs and the owners' standard minimum profit of 17 per cent., the amount of the standard wages is 12.11 per cent. on the 1915 standard rates. As, however, the owners are liable under their agreement to pay 28 per cent., this means a loss to them of £247,000. All that the coalowners' representatives on the Conciliation Board promised to do was to consider the facts and arguments submitted by the workmen and place them before the Coalowners' Association in due course. The President of the men's Federation told the owners that if no action was taken then, there would be no alternative but for the workmen to adopt their own course. Since then the Executive Council of the Federation has had a meeting, but nothing definite has happened, although it is very probable that a coalfield delegate conference will be called eventually to consider the whole situation. Meanwhile, the Western District Association of the miners' organisation has passed a resolution urging the Executive to call a national conference for the purpose of reviewing the whole position arising out of the present coalfield agreement, and demanding a living wage, together with uniformity in wages.

Trouble at Ebbw Vale.

The relations between the officials and the miners at the Ebbw Vale Company's collieries are very strained, and it looks very much as if there is a prospect of the whole of the pits coming to a stop. According to the men's district agent, consultation has taken place with other sections of the Ebbw Vale Company's undertakings, and it is the men's intention to bring the whole place to a standstill. Letters have been exchanged between the Miners' Executive and the chairman of the company. The former makes a series of charges against the officials of the company as to their high-handed and overbearing action towards workmen, it being described as reminiscent of that of German officers during the period of occupation. Sir Frederick Mills, the chairman of the undertaking, in his reply, complains of the tenour of the men's communication, points out that they are faced with the most difficult industrial period in his recollection, states that it is clear to him that the only way in which they can deal with the questions before them is by a marked reduction in the cost of production of coal, and, in turn, in iron and steel, and that he does not find in the men's letter one solitary word which is helpful to that end. A mass meeting of the men unanimously decided to leave themselves in the hands of their officials and to carry out any mandate that the officials might give them. There is to be a further mass meeting on Sunday next to review the position.

Shipping Facilities and Charges.

There is very general dissatisfaction with the concessions so far made in dock and railway charges. Railway tolls are per ton still double pre-war charges, the cost of tipping and weighing at the docks is 389 per cent. above pre-war and dock and railway tolls on pitwood from the docks to the collieries are no less than 145 per cent. in advance of the charges of 1913. All interested in the coal trade, whether as exporters, shipowners, &c., met at Cardiff on Tuesday, under the presidency of Mr. R. O. Sanderson, the President of the Cardiff Chamber of Commerce, when the report of the joint committee representative of the South Wales Chambers of Commerce, the Coalowners' Association, the shipowners and other organisations was submitted. The committee asked for shipment facilities "all round the clock," but it appears that the dock companies favoured the introduction of a two split shift system, by which they thought they would be able to increase the shipments by 20 per cent. without the extra expense involved in continuous working. Some of those present at the meeting condemned the present "follow-on" system of ships going under the tip and strongly advocated the "turn" system, by which ships are loaded in the order in which they arrive at port. Ultimately, a resolution was passed expressing the view that the reductions in dock and railway charges which have been granted are inadequate, that further reductions are needed, and that steps should be taken by the joint committee with that object and for securing improved facilities for the shipment of coal, including consideration of the "follow-on" system.

Current Business.

With very few exceptions, collieries are in need of orders: at least, they can do with considerably more business to put them in a comfortable position. This applies more particularly to large coals, as owing to production of these qualities being curtailed, the quantity of small coals is limited, and the market for the latter, as a consequence, keeps very steady. The inquiry from abroad is on the quiet side, and for the orders that are open to competition, prices have to be cut to a fraction by firms if they are to be successful. In fact, there is scarcely any profit in the transaction when it is executed. Best large steams are about 24s. 6d. to 25s. and best steam smalls are 18s. to 19s. Patent fuel is about steady, foundry coke being 35s., and pitwood lower at 30s. to 32s. 6d.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Midland Pig Iron Prices and the Cleveland Drop.

THE further drastic reduction in Cleveland pig iron of 10s. per ton, announced this week, must have a great effect upon prices in the Midland market. This is the more so since it is the third official deflation of an equal amount making 30s. in all within the past few weeks. Evidently the North of England makers are resolved upon getting their blast-furnaces to work again at all costs. It is a little early yet to gauge the precise amount to which Derbyshire, Northamptonshire and similar pig irons will be influenced by this week's drop in Cleveland prices, but it may be accepted as a very good guide that on each of the previous occasions of the 10s. fall on the North-East Coast our Midland irons immediately fell between 2s. 6d. and 5s. per ton.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

A slightly better tone was in evidence this week and prompt tin-plates are now 20s. basis f.o.b. for standard make, while for delivery over the next two months prices are about 19s. 6d. to 19s. 9d. f.o.b. The market is rather better inclined. In the galvanised sheet section the tone is dull. Sheet and tin bars show no change from the official minimum of £7 15s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

DUNLOP AND RANKEN, Limited, of 9, Park-lane, Leeds, ask us to state that their telephone number has been changed from 20,477 to 27,301.

MESSRS. CAREY AND LATHAM, of 36, Victoria-street, London, S.W. 1, inform us that, as from January 2nd, 1922, Mr. Percy Harrison, Assoc. M. Inst. C.E., has joined the firm, and is now one of its partners.

WE are informed that Mr. W. Rutherford, formerly managing director of Dick, Kerr and Co., Limited, and subsequently of the English Electric Company, Limited, has been elected a director of G. D. Peters and Co., Limited.

WE are asked to state that Burton, Griffiths and Co., Limited, of 70, Vauxhall Bridge-road, London, S.W., have been appointed sole agents for Great Britain for the productions of the Toledo Machine and Tool Company, of Toledo, Ohio, U.S.A.

WE have been informed that the business formerly carried on under the style of Gallwey, Paul and Barker, of 40–41, Great Marlborough-street, London, W. 1, has been incorporated as a private company, and will be carried on under the style and title of Paul and Barker, Limited, at the same address.

CONTRACTS.—Boving and Co., Limited, have recently been awarded a contract by the Government of New Zealand for water turbines in connection with the Mangahao hydro-electric power scheme. The order includes the supply of five main Pelton wheels—three, each having a maximum output of over 8000 brake horse-power, and two, each over 4000 brake horse-power; also two smaller exciter Peltons, each 325 brake horse-power. The wheels will work under an average head of water of 825ft.—We are asked to state that the following streets in Birmingham have been reconstructed with concrete foundations, reinforced with B.R.C. fabric, Ref. No. 9:—Moor-street, Broad-street, Bristol-street, Lawley-street, Coventry-road, and Hagley-road. The work in each case was started in August or September, 1921.

FINSBURY TECHNICAL COLLEGE.—The closing of the winter term at the Finsbury Technical College was marked by an interesting cinema lecture, which was given on December 9th, before the entire staff and students of the Engineering Faculty. The chair on the occasion was taken by Mr. J. K. Catterson-Smith, chief electrical lecturer. The film and projector had been lent by the British Thomson-Houston Company, Limited, Rugby, and the exhibition represented the manufacture, at Rugby, of a B.T.H. Curtis turbo-alternator, the various processes in the manufacture of both turbine and alternator being shown step by step until the complete machine was seen under working conditions. The turbo-alternator dealt with was of 40,000 horse-power capacity, the largest power unit yet constructed in Great Britain. At the close of the lecture the chairman thanked Mr. B. E. Williams, a third year electrical student at the College, on behalf of those present, as the originator of cinema lectures in the College, and for his efforts in bringing about what had been a most instructive and interesting afternoon. He also expressed, through Mr. Williams, the meeting's thanks to the British Thomson-Houston Company, Limited. The suggestion that the College should purchase a projector of its own was accorded the whole-hearted support of those present, and it is hoped the suggestion will materialise during the present session.

Current Prices for Metals and Fuels.

IRON ORE.

N W. COAST—	
Native	37/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	26/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 15 0	—
No. 1 Foundry	5 12 6	—
No. 3 ,,	5 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 2 6	5 2 6
Cleveland—		
No. 1	4 15 0	5 0 0
Silicious Iron	4 15 0	5 0 0
No. 3 G.M.B.	4 10 0	4 15 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 2 6	4 2 6
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
Staffs.—		
All-mine (Cold Blast)	15 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. Foundry	5 0 0 to 5 5 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 5 0 to 4 7 6	
,, Forge	4 0 0	—
(3) Derbyshire—		
No. 3 Foundry	4 5 0 to 4 10 0	
Forge	4 0 0 to 4 2 6	
(3) Lincolnshire—		
Basic	4 5 0 to 4 7 6	
Foundry	4 12 6 to 4 15 0	
Forge	4 5 0 to 4 10 0	
(4) N.W. COAST—		
N. Lancs. and Cumb.		
Hematite Mixed Nos.	6 5 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best ,,	17 0 0	—
N.E. COAST—		
Common Bars	12 10 0	—
Marked ,,	18 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	13 0 0	—
Hoops	16 5 0	16 0 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best ,,	14 0 0	—
Hoops	16 0 0	—
MIDLANDS—		
Marked Bars (Staffs.)	16 0 0	—
Crown Bars	12 0 0 to 13 0 0	
Nut and Bolt Bars	12 0 0 to 12 5 0	
Gas Tube Strip	13 10 0	—
Hoops (*Nom.*)	16 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	14 0 0	—
Ship Plates ¾in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ¾in.	12 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	16 0 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	9 10 0	—
Soft Billets	7 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
MANCHESTER (*Prices irregular and uncertain, unchanged*)—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0 to 13 0 0	
Bessemer Billets	12 0 0	—
Hard Basic	10 0 0	—
Soft ,,	8 0 0 to 9 0 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	10 0 0	—
Bessemer Billets	7 10 0 to 8 0 0	
(2) Hoops	12 0 0 to 12 10 0	
Gas Tube Strip	10 15 0	—
Sheets (24 W.G.)	15 0 0	—
Galv. Sheets (f.o.b. L'pool)	16 10 0 to 17 10 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	9 10 0 to 10 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 20/3
Block Tin (cash)	165 5 0
,, (three months)	167 0 0
Copper (cash)	65 7 6
,, (three months)	66 5 0
Spanish Lead (cash)	24 10 0
,, (three months)	24 5 0
Spelter (cash)	26 15 0
,, (three months)	27 2 6
MANCHESTER—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	73 10 0
,, Strong Sheets	98 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	26 0 0
,, Foreign	24 10 0

(*Metal prices practically unchanged*).

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£28	12/-
,, 6 p.c. to 8 p.c. ,,	£26	10/-
,, 8 p.c. to 10 p.c. ,,	£26	10/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese	(per ton) £18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	21/- per lb.	
,, Molybdenum	9/ per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£180	
Cobalt	14/6 per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	Export.
SCOTLAND.	
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	23/3
,, ,, Ell	23/3
,, ,, Splint	24/- to 29/-
,, ,, Trebles	26/-
,, ,, Doubles	23/6
,, ,, Singles	18/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	23/-
,, ,, Splint	24/-
,, ,, Trebles	26/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	20/- to 24/-
Screened Navigation	28/-
Trebles	26/-
Doubles	23/6
Singles	18/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	23/-
Secondary Steam	22/6
Trebles	26/-
Doubles	23/6
Singles	18/-
ENGLAND.	
(8) N.W. COAST—	
Steams	34/-
Household	40/- to 55/-
Coke	31/-
NORTHUMBERLAND—	
Best Steams	23/6 to 24/6
Second Steams	21/6 to 22/
Steam Smalls	14/-
Unscreened	21/6
Household	25/- to 30/-
DURHAM—	
Best Gas	21/6 to 22/-
Second	20/- to 21/-
Household	25/- to 30/-
Foundry Coke	32/- to 33/-
SHEFFIELD—	**INLAND.**
S. Yorks. Best Steam Hards	24/- to 25/-
Derbyshire Hards	23/- to 24/-
Seconds	22/- to 23/-
Cobbles	23/- to 23/-
Nuts	21/- to 22/-
Washed Smalls	17/- to 18/-
Best Hard Slacks	17/6 to 18/6
Seconds ,,	17/- to 17/6
Soft Nutty ,,	17/- to 17/6
Fine ,,	11 6 to 12,6
Small ,,	9/- to 10/-
House, Branch	39/- to 41/-
,, Best Silkstone	37 6 to 39/-
Blast Furnace Coke (Inland and Export)	22/6 to 27/6
CARDIFF—	**(9) SOUTH WALES.**
Steam Coals:	
Best Smokeless Large	24/6 to 25/-
Second ,, ,,	24/- to 24/6
Best Dry Large	24/6 to 25/-
Ordinary Dry Large	24/- to 24/6
Best Black Vein Large	23/- to 23/6
Western Valley ,,	22/6 to 23/-
Best Eastern Valley Large	22/6 to 23/-
Ordinary ,, ,,	21/6 to 22/6
Best Steam Smalls	17/6 to 18/6
Ordinary ,,	12/6 to 17/6
Washed Nuts	27/6 to 30/-
No. 3 Rhondda Large	27/6 to 30/-
,, ,, Smalls	19/- to 20/-
No. 2 ,, Large	22/- to 23/-
,, ,, Through	19/- to 21/-
,, ,, Smalls	15/- to 16/-
Coke (export)	32/6 to 37/6
Patent Fuel	25/- to 27/6
Pitwood (ex ship)	29/- to 31/-
SWANSEA—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	45/- to 50/-
Red Vein	40/- to 45/-
Big Vein	50/- to 52/6
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	55/- to 57/6
Peas	20/- to 22/-
Breaker Duff	7/6 to 7/9
Rubbly Culm	10/- to 11/-
Steam Coals:	
Large	24/- to 25/-
Seconds	23/- to 24/-
Smalls	12/6 to 16/-
Cargo Through	20/- to 22/-

(1) Delivered (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Reparation and Reconstruction.

THE difficulty that stands in the way of France coming into line with other countries over the question of carrying out a programme of economic reconstruction for the whole of Europe lies in the fact that this country is not so much affected by the existing situation as others which are suffering from the disaster that has overtaken all the foreign markets. Purely industrial countries which depend almost entirely upon foreign trade are more hardly hit than those which suffered devastation from the war. This country is only partly industrial, and there is no absolute necessity for foreign markets, except for certain products like silks and wines, of which the production is nearly always in excess of home requirements. There is no need to go abroad for anything essential to the country's existence with the exception of fuels and oils, and the policy of France is to render the country as much as possible independent of even these importations by utilising hydraulic power and making the most of the considerable quantities of power alcohol that can be produced at home, and more especially in the colonies. Particular attention is given to the future colonial development which, it is hoped, will eventually provide the mother country with everything it may need, and the forthcoming colonial exhibition at Marseilles, to be followed by an inter-Allied colonial exhibition in Paris in 1925, point to the preponderating importance of the colonies as a means of making France entirely self-supporting. Under these circumstances, the question of international trade does not receive the same attention as it does in purely industrial countries. Whatever may be done to carry out the economic reconstruction of Europe, it can only be accomplished progressively, and its effects are not likely to be felt generally for some time to come. Consequently, France is looking to her immediate needs. There is an enormous amount of work to be done in the country if only the money were available, and the national finances are in a very critical condition unless Germany can be made to pay the amount fixed for reparation. In anticipation of German payments the Government has advanced considerable sums of money for reconstruction work in the devastated regions, which the French Government is naturally anxious to have refunded. There is also the question of cokes and coal and other raw material which Germany has undertaken to supply. The metallurgical industry in the Est, and especially in Lorraine, cannot develop without a much larger supply of cokes than is at present forthcoming. The Wiesbaden agreement was intended to supply France, and especially the devastated regions, with such material as is required for reconstruction and industrial development. It is, therefore, argued that as the amount of work to be carried out in France will be sufficient to keep the home industry busy for some years, if only it be possible to procure the necessary funds, the interest of France lies in compelling Germany to fulfil her engagements to pay the amounts fixed for reparation, and as apparently that country is not in a position to pay the full amount it should make up for any deficit with such material as may be necessary for the country's commercial development, and especially for the opening up of the vast colonial domain.

Moving Platforms.

In view of the difficulty of finding a solution of the traffic problem in Paris, which has become increasingly serious during the past few years with the development of vehicular traffic and the larger number of motor omnibuses and tramcars, the Municipal Council recently gave favourable consideration to a proposal to establish moving platforms under the main boulevards and other congested thoroughfares. It was decided that an experimental platform should be laid under the Avenue de l'Opéra. The Council has now opened a public competition for plans which must be submitted not later than January 20th, 1923, to the Direction Générale des Travaux de Paris et du Département de la Seine, 98, Quai de la Rapée, Paris (12e), where copies of the programme can be obtained. Foreigners are allowed to compete on condition of their obtaining permission from the Prefet de la Seine at least three months before the closing date. The competitor must submit a full written description of his system with an idea of its cost, together with plans and an explanation of the methods whereby it is proposed to minimise the noise. He must also state the manner in which preliminary trials of the system can be carried out, and the estimated approximate cost, which will be borne by the Town of Paris. Three premiums of 100,000f., 50,000f., and 30,000f. will be awarded for the best schemes, and in the event of the Municipal Council adopting one of the schemes it may purchase it outright for half a million francs, or for such sum as may be fixed by arbitration should only a part of the scheme be utilised.

An Exhibition Palace.

Since the era of universal exhibitions was brought to a close in 1900, it has been found impossible to organise any manifestation of a similar kind on a large scale through the absence of suitable sites and buildings. As far back as 1912 it was decided to construct a huge exhibition palace which would be employed for the annual agricultural shows as well as for exhibitions, and soon after the Armistice plans were prepared for a vast building of which the construction was to have been started upon in April last outside the fortifications between the Porte Molitor and the Porte de St. Cloud. As the Paris Municipal Council was unable to provide the necessary funds, and the site was strongly objected to, the State has now decided to carry out the undertaking and construct the palace in the Bois de Vincennes in a park of about 20 acres. It is intended to give a particularly decorative character to the palace, which will be one of the largest of its kind in the world. A permanent colonial museum will be installed in the park, and the palace will be ready for the inter-Allied colonial exhibition to be held in 1925.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

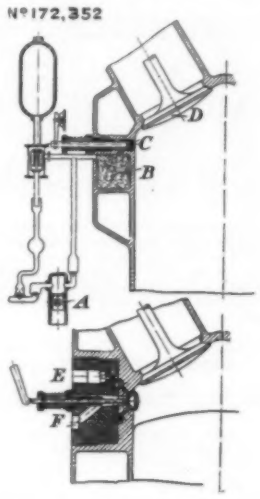
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

172,352. July 8th, 1920.—FUEL INJECTION VALVES, H. Wade, 111 and 112, Hatton-garden, London, E.C. 1.

According to this system of fuel injection the pump A maintains the oil in the reservoir B under pressure, and supplies an amount in excess of the engine's requirements. The surplus goes back to the pump suction by way of the overflow shown. The fuel valve C is so placed, with respect to the air inlet valve

No 172,352



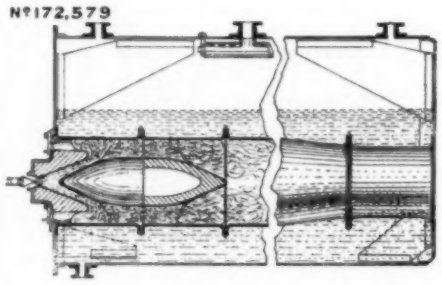
D, that the spray of oil is thoroughly mixed with the incoming air. The lower illustration shows another form of atomiser. The oil is supplied at E and finds its way through an annular channel to very fine holes opening into a conical slot. Gases from the engine exhaust are led to F, and, flowing through the conical slot, atomise the oil.—*December 8th*, 1921.

STEAM GENERATORS.

172,579. June 2nd, 1921.—OIL-FIRED FURNACES, W. Lees, 21, Stockport-road, Mottram-in-Longendale, near Manchester.

The inventor claims that the use of the divergent conical

No 172,579



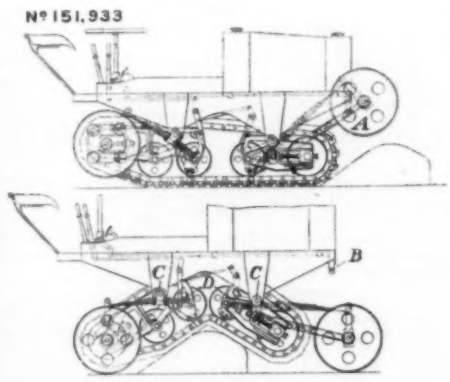
entrance and lozenge-shaped baffle shown in the drawing, both of which are made of refractory material, improve the ignition, combustion and distribution of the flame from oil fuel.—*December 15th*, 1921.

MOTOR CARS AND ROAD TRAFFIC.

151,933. September 25th, 1920.—ENDLESS TRACK VEHICLES, A. de Virel and M. E. Cahen, 111, Avenue Victor Hugo, Paris.

This vehicle is intended for running either on its endless tracks or on road wheels. The front road wheels A are provided with

No 151,933



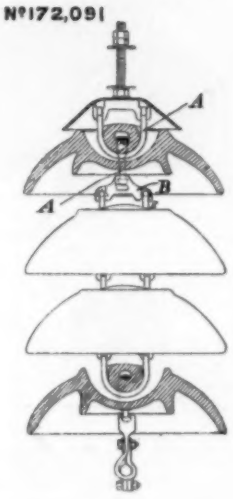
steering mechanism. When it is desired to use the road wheels the catches B, which hold up the front wheels, are released and the wheels drop of their own weight. The vehicle is then driven over a hump, as shown in the lower view, and the carrying frames thus made to rotate about their pivots C C. Catches D D are then engaged with the inner ends of the frames, which are consequently held in the new position and the tracks are kept off the ground.—*December 8th*, 1921.

TRANSMISSION OF POWER.

172,091. August 25th, 1920.—INSULATING CHAIN FOR ELECTRIC TRANSPORT LINES, Edmond Louis Gely, of 40, Rue de la Trinité, Toulouse, France.

The insulating chain described in this specification consists of a number of insulators of the type shown assembled together

No 172,091



by metallic attachments, such as U-shaped arms A, which are placed in semi-circular apertures in the insulators. Intermediate members B are attached to the ends of the U-shaped arms.—*November 25th*, 1921.

157,979. January 11th, 1921.—HYDRAULIC SPEED REDUCING GEAR, A. G. M. Michell, 450, Collins-street, Melbourne, Australia.

In this hydraulic transmission gear, which is intended for marine service, there are two pumps connected with the prime movers. These pumps supply water to an inward flow turbine on the propeller shaft. The turbine has two sets of buckets.

No 157,979

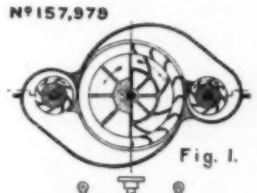


Fig. 1.

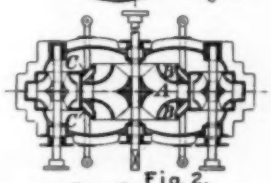


Fig. 2.

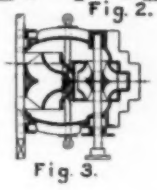


Fig. 3.

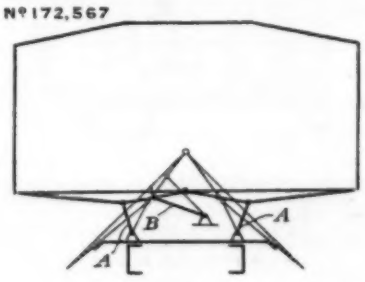
The inner set A is arranged for going ahead, while the twin outer set B B is for going astern. The delivery from the pumps is diverted to one or other of the sets of buckets by the annular gates C C. Fig. 2 shows the gates set for going ahead, while in Fig. 3 the machine is arranged for going astern.—*December 8th*, 1921.

TRAMWAYS AND RAILWAYS.

172,567. March 29th, 1921.—SELF-DISCHARGING WAGONS, *T. W. Rogers*, 33, *Chancery-lane, London.*

In this bottom-discharging wagon, the doors are hinged

No 172,567



together at the centre, and are supported by swinging links A A. A rod B connects one of the doors with a fixed part of the underframe. Before the wagon is loaded, the doors are fixed by catches, and when these are released the doors take up the position shown by the faint lines, and discharge the load. The

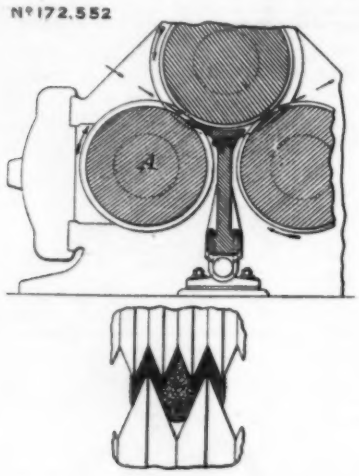
connecting-rod B ensures the doors opening equally.—*December 15th*, 1921.

CRUSHING AND GRINDING.

172,552. February 5th, 1921.—CANE MILLS, *R. L. Goold*, 5, *Corporation-street, Birmingham.*

In order to improve the extraction of juice from sugar cane, in mills, the inventor provides the feed roll A with grooves, which are large by comparison with the grooves in the other

Nº 172,552



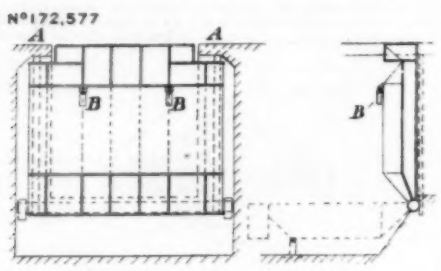
rolls. These deep grooves are said to conduct the juice away into the pan below more readily than those of smaller pitch, and check its being returned to the bagasse again after it has been expressed.—*December 15th*, 1921.

SHIPS AND BOATS.

172,577. May 13th, 1921.—DOCK GATES, E. Box, 10, Washington-terrace, North Shields.

These drop gates for docks have the upper corners cut away, as shown at A A, so that the coping of the dock wall may be extended to protect the closing face from damage by collision

Nº 172,577



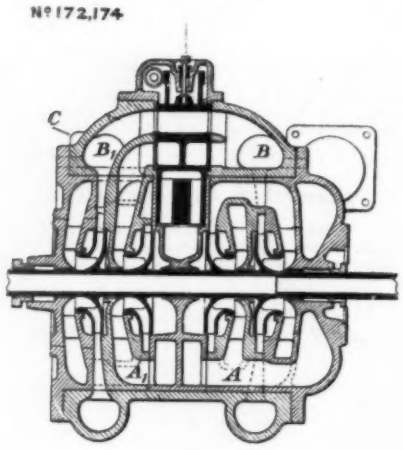
with a vessel entering the dock. At the back of the gate hinged props B B are provided, which rest on the bottom and support the gate when it is open, as shown by the dotted lines.—*December 15th* 1921.

PUMPING AND BLOWING MACHINERY.

172,174. October 1st, 1920.—MULTI-STAGE CENTRIFUGAL PUMPS, *B. E. D. Kilburn*, 31–33, *High Holborn, London, W.C.* 1.

In this four-stage pump a valve and internal passages are so arranged that the four impellers can be worked in series or in parallel groups of two. The illustration shows the parallel arrangement. The water first passes to the inner impellers by way of the suction chambers A A_1. It then goes to the outer

Nº 172,174



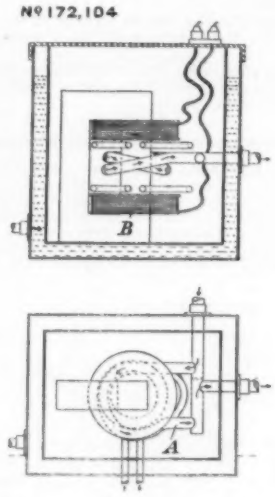
impellers, the connecting passage for which purpose is most plainly shown on the right. The discharge takes place through the chambers B B, and is led away at the outlet C. For series working the plug valve, shown black, is turned through 90 deg. B is then put in communication with A_1, B is separated from B_1, and the two suction chambers A A_1 are isolated from one another. —*December 8th*, 1921.

LIGHTING AND HEATING

172,104. August 30th, 1920.—IMPROVED ELECTRIC WATER HEATER, Robert John Frost, of Clayton, Victoria, Australia.

Briefly stated, this invention relates to the employment of a metallic water pipe or conduit, so associated with an alternating-current transformer B as to constitute the secondary circuit of the transformer, the metallic conduit being short circuited and the water to be heated is caused to flow through the pipes. The transformer is situated within a casing provided with a water jacket and a cover and the primary conductors are pro-

Nº 172,104



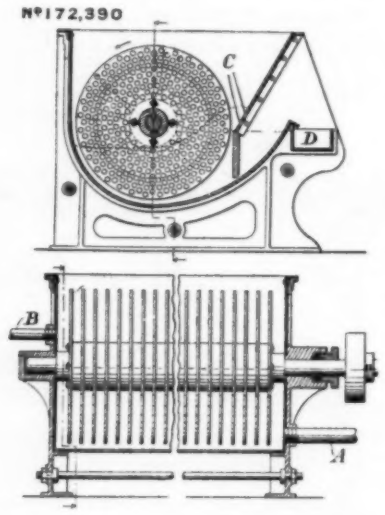
tected against destructive heat effect by water circulating conduits. The metallic water pipe through which the water to be heated passes, is turned around the core of the transformer to form a secondary circuit, the pipe being short circuited by a bridge and connected with a delivery pipe so that the current induced in the secondary circuit constituted by the conductor heats the water.—*November 30th*, 1921.

MINES AND METALS.

172,390. September 2nd, 1920.—SEPARATION OF ORES BY FROTH FLOTATION, *F. I. Brougham*, 10, *New-court, Lincoln's Inn, London.*

In this froth flotation machine the mineral pulp is supplied through the inlet A, and the tailings taken away at B. Running along the length of the tank there is a shaft which is provided with a number of discs, so formed on their surfaces that they

Nº 172,390



tend to entrap air and drag it down into the pulp as the shaft revolves. The froth thus formed escapes by the openings C, and carries the mineral over into the launder D, while the pulp flows back into the tank again.—*December 2nd*, 1921.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

ELECTRO-HARMONIC SOCIETY.—Great Hall, Cannon-street Hotel. Smoking Concert. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, Westminster, S.W. 1. "Artificial Ice," by Mr. E. C. West. 8 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Lecture Theatre, Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. "The Use of Compressed Air in Diesel-engined Ships," by Mr. Wm. Reavell. 6.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Memorial Hall, Albert-square, Manchester. Discussion, "Shop Management," to be introduced by Sir Henry Fowler. 7 p.m.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN.—University Engineering Building, Liverpool. "The Vyrnwy Aqueduct," by Mr. F. W. Gaskin. 7.30 p.m.

SATURDAY, JANUARY 14TH.

INSTITUTION OF BRITISH FOUNDRYMEN.—College of Technology, Manchester. Annual Dinner. "The Solution Theory of Alloys, with special reference to Cast Iron," by Dr. F. J. Brislee. 4 p.m.

MONDAY, JANUARY 16TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Y.M.C.A., Albion-place, Leeds. Paper, "Steel for Locomotive Purposes," by Sir Henry Fowler. 7.30 p.m.

TUESDAY, JANUARY 17TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street. "The Influence of Time and Temperature on the Properties of Alloys," by Professor C. A. Edwards. 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—The Minories, Tower-hill, E. 1. "Weather at Sea, including Clouds, Waves, &c.," by Sir D. Wilson-Barker. Lantern. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Metropole, King-street, Leeds. Paper, "Single and Three-phase Alternating-current Commutator Motors, with Series and Shunt Characteristics," by Dr. S. P. Smith. 7 p.m.

THE ENGINEERS' CLUB.—Albert-square, Manchester. "Relationship of Finance to the Engineering Industry," by Mr. H. G. Williams. 7.15 p.m.

WEDNESDAY, JANUARY 18TH.

INDUSTRIAL LEAGUE AND COUNCIL.—Caxton Hall, Caxton-street, S.W. 1. "Use and Abuse of Combines and Trusts," by Mr. Robert Young. 7.30 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, S.W. Presidential address. "The Weather and the Crops in Eastern England, 1885, 1921," by Mr. R. H. Hooker. 7.30 p.m.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. "Ball Bearings," by Mr. R. Allan. Lantern. 7.30 p.m.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Institute of Chartered Patent Agents, Staple Inn Buildings, Holborn, W.C. Discussion on "Methods of Remunerating Labour," to be opened by Mr. W. H. Allingham. 7 p.m.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Resumed discussion on paper, "Three-position Signalling," by Mr. A. E. Tattersall. 3 p.m.

THURSDAY JANUARY 19TH.

INSTITUTION OF CIVIL ENGINEERS (YORKSHIRE SECTION).—Gt. Northern Fly. Hotel, Wellington-street, Leeds. First Annual Dinner. 6.30 for 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment. Discussion on "The Utilisation of Waste Heat from Electrical Generating Stations," to be introduced by Messrs. C. I. Haden and F. H. Whysall. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "Aeroplane Installation," by Brig.-General R. K. Bagnall-Wild. 5.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Municipal College of Technology, Sackville-street, Manchester. Lecture, "Jigs, Fixtures, &c., Design, Manufacture and Influence over Design of Product," by Mr. T. Elliott. 7 p.m.

FRIDAY, JANUARY 20TH.

INSTITUTE OF TRANSPORT.—Royal Society of Arts, John-street, Adelphi. Graduates' and Students' Lecture. "The Operation of an Important Railway Goods Terminal," by Mr. G. T. Hedge. 5 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow. "Centrifugal Castings," by Mr. F. E. Hurst. 7 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall, University of Sheffield. "An Investigation of Some Defects in Silver-plating Anodes," by Messrs. F. C. Robinson and H. G. Dale. 7.30 p.m.

THE INSTITUTION OF CIVIL ENGINEERS, BIRMINGHAM AND DISTRICT ASSOCIATION; THE INSTITUTION OF MECHANICAL ENGINEERS, MIDLAND DISTRICT; THE INSTITUTION OF ELECTRICAL ENGINEERS, SOUTH MIDLAND DISTRICT.—Council House, Birmingham. Joint discussion on "The Electrification of Main-line Railways." Speakers: Messrs. Wm. Willox, C. F. Bengough, H. N. Gresley, J. A. Hookham, R. T. Smith, F. W. Carter. 7 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse on "Soap Films and Molecular Forces," by Sir James Dewar. 9 p.m.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN: MERSEYSIDE BRANCH.—Walker Engineering Building, The University of Liverpool. Lecture, "The Tides," by Professor J. Prowdman. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. "Some Observations on a Producer Gas Power Plant," by Messrs. H. S. Denny and N. V. S. Knibbs. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. Lecturette, "Geology in its relation to Engineering." 8 p.m.

FRIDAY AND SATURDAY, JANUARY 20TH AND 21ST.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: SOUTH-WESTERN DISTRICT.—At Council Chamber, Plymouth. At 3 p.m. on Friday. Saturday's programme will be devoted to a series of excursions.

MONDAY, JANUARY 23RD.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. Informal meeting. Discussion, "Electrical Vehicles: Present and Future," to be opened by Mr. R. J. Mitchell. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W. 1. Paper, "Airships," by Mr. F. Arnold Best. 7 p.m.

TUESDAY, JANUARY 24TH.

THE NEWCOMEN SOCIETY.—Caxton Hall, Westminster. Paper, "Mechanics of Engineering from the Time of Aristotle to that of Archimedes," by Dr. T. E. Lones. 5 p.m.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—Great Hall, London School of Economics, Aldwych, W.C. Lecture, "Industrial Economics in relation to the Bearing on National Welfare of the Ascertainment of Cost," by Mr. J. M. Felbs. 8 p.m.

FRIDAY, JANUARY 27TH.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. Lecturette, "Fuels and the Boiler-house," by Mr. L. M. Jockel. 8 p.m.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The Engineers' Club, Coventry-street, W. Smoking concert and informal dinner. 7 p.m.

TUESDAY, JANUARY 31ST.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Paper on "Tidal Power Development," by Professor A. H. Gibson, D.Sc. 6.30 p.m.

ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi. Discussion, "The Use of Light as an Aid to Aerial Navigation," to be opened by Lieut.-Colonel L. F. Blandy. 8 p.m.